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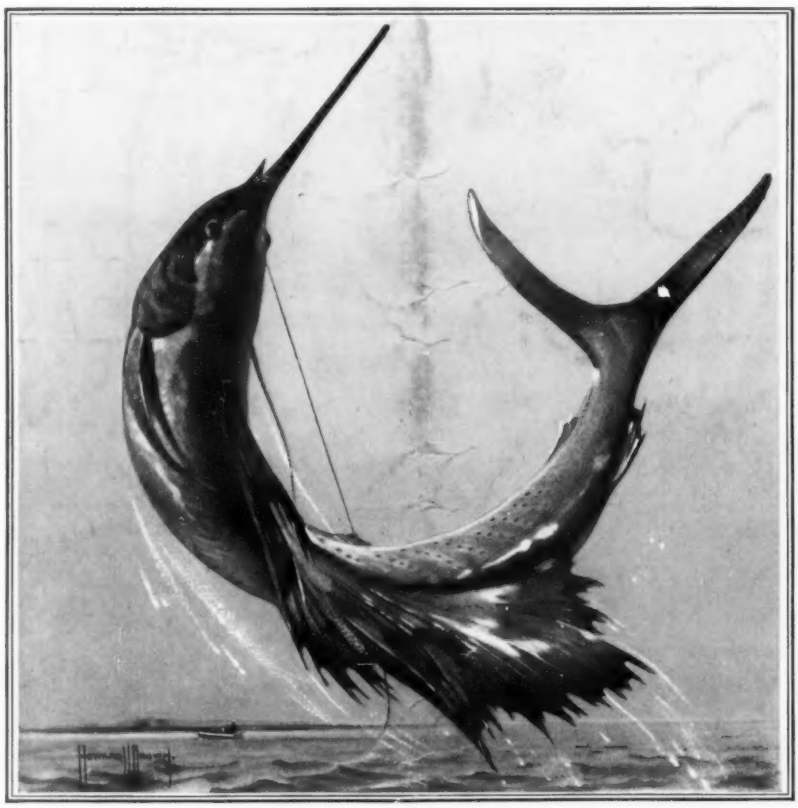


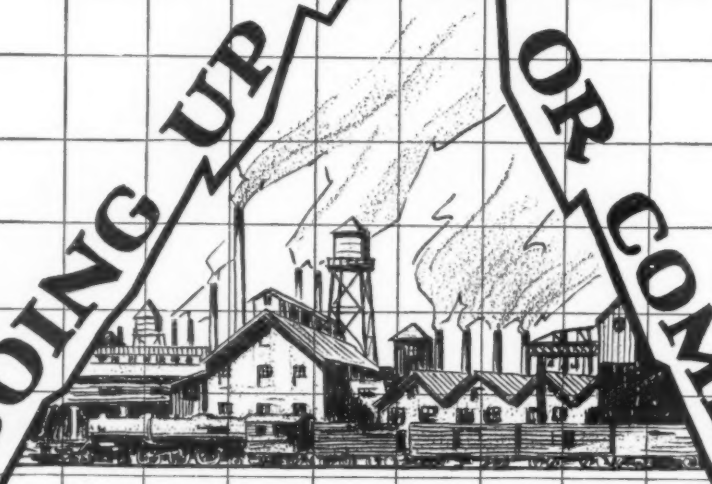
BIG GAME FISH OF NEW ZEALAND SEAS

NEANDERTHAL MAN *NOT* OUR ANCESTOR

MILLIKAN TELLS OF COSMIC RAYS

OVERHEAD

GOING UP OR COMING DOWN?



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SCIENTIFIC AMERICAN

24 WEST 40th STREET — NEW YORK CITY

August 1928 — *Edited by ORSON D. MUNN* — *Eighty-fourth Year*

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COVER

At about the time that Zane Grey's article on big game fish (see page 116) was accepted for publication, the editor was taking motion pictures of fish and fishing scenes off the coast of Florida. By a stroke of good fortune, his camera was trained properly just as a large sailfish was hooked, and subsequent feet of film recorded a series of spectacular jumps. Our artist, Howard V. Brown, has transferred to oil paints and canvas the thrilling beauty of these leaps, and the result is a fitting introduction to the interesting story which Mr. Grey has to tell. Incidentally, the sailfish illustrated was subsequently landed after a hard battle, and is being mounted for our editorial office as an inspiration to other anglers of the staff.

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Looking Ahead
With the Editor

Australia's "Wild West"

IS the black of Australia's bush, hundreds of miles from even the smaller settlements, the lowest of human types? He wears no clothes; lives in a lean-to; and the family possessions consist of a digging stick, a wooden bowl, a tin can or two, a boomerang, a club, and a few stone knives. But in some ways he is quite intelligent according to the writer of an article to appear shortly. This is a story well worth the waiting.

Now Let Us Have the Truth!

WHAT'S all the furor about? It *has* been hard to understand, hasn't it? Naval limitations, cruiser size and strength, and related questions have brought forth such a flood of argument, resounding criticisms, lectures, newspaper "talk," inconsistent bombast, and even peace sermons, that most of us are "in the dark." The answer, authoritatively, concisely, and fully told, is coming in a new series. You won't want to miss it.

100,000 Years Old

RESEMBLING in some ways the famous Rancho-la-Brea tar pools near Hollywood, the McKittrick fossil quarry in California has given up fossils of the mastodon, camel, llama, lion, saber-toothed tiger, and numerous other animals. When collected and identified, they give a fairly good indication of what animal life must have been like in California 100,000 years ago. This "find," the subsequent excavations, and the method of preserving the fossils, is the subject of an early article.

Three Years Abaft the Mast

THE Earth's magnetism is constantly varying. A ship, following Columbus' compass-course, would land at an island 660 miles southeast of where he landed. To keep track of these changes and learn facts concerning the ocean and its caprices, the non-magnetic ship, *Carnegie*, of the Carnegie Institution, sailed in May for a three-year 'round-about-the-world trip. An article now on hand tells interestingly about this trip and describes the equipment on the scientific square-rigger.

"I'll Have An Oyster Steak"

IT hasn't quite come to that, although the bivalves grown in Puget Sound are so large they are called "beefsteak" oysters. An article ready for release describes the development of this industry in that locality, tells how the "seeds" for this "farm" are collected in Japan, shipped, sown, grown in land prepared and surrounded by dikes, and finally gathered and shipped. In many ways the methods used are unique.

Every Issue Fully Illustrated

¶Read this magazine carefully. If you like it, you will like succeeding issues also. Better make sure of getting it regularly every month. A subscription, costing only four dollars, brings 12 issues to you.

Among Our
Contributors

Robert A. Millikan

Dr. Millikan has become noted because of his remarkable researches. He was the first to weigh the electron—a piece of work for which he was awarded the Nobel Physics Prize. His more recent analysis of the cosmic ray has frequently brought him into public prominence rather more, perhaps, than many other scientists. The things he is finding out are likely, however, to be regarded by posterity as fundamental in the realm of scientific research.

Zane Grey

There is scarcely any necessity for introducing Mr. Grey except for the fact that this great novelist now writes a different kind of story. He is well equipped by experience, however, to tell about big game fish; for, besides being an author, he is an outdoors man, a sportsman, and is interested in museums.

G. Elliot Smith

Professor Smith is one of the world's foremost authorities on evolution, particularly that of man, and more particularly of man's brain, which is the main factor which differentiates man from his cousins, the living apes. He is the author of "Essays on the Evolution of Man" in which he sets forth his views more fearlessly than many scientists. He is a professor in the Institute of Anatomy, University of London.

Russell W. Porter

An architect, artist, arctic explorer with Peary and others, Mr. Porter took up optical work and developed the well-known screw-thread comparator. It is he who is co-operating with SCIENTIFIC AMERICAN in the campaign for the encouragement of astronomy through the making of amateur telescopes.

W. F. G. Swann

Recognized as one of the ablest physicists of the world, Professor Swann, an Englishman, was Professor of Physics at Yale until last year. He now directs physics research at The Franklin Institute in Philadelphia. His thorough work has always attracted widespread attention from other scientists.

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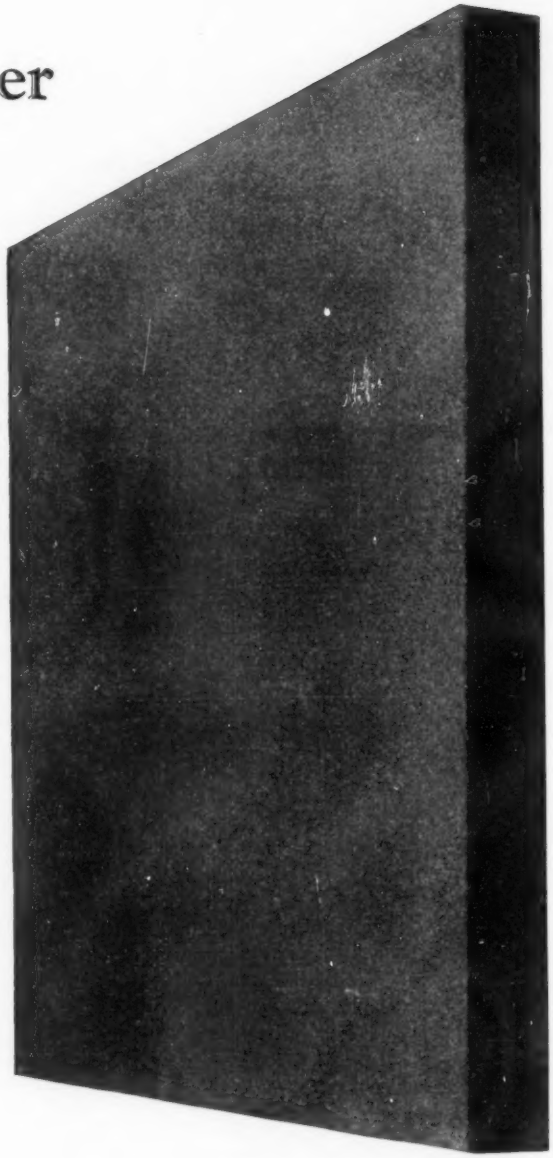
The modern activated sludge system of sewage disposal requires Porous Plates of strength and time defying qualities. The electric furnace abrasive, trademarked Alundum, the same basic material used in the making of grinding wheels, refractories, and slip-proof floors possesses the quality necessary for the successful performance of this service.

The great sewage disposal plant shown in the photograph is a typical installation of Norton Porous Plates.

Norton Company, Worcester, Mass.



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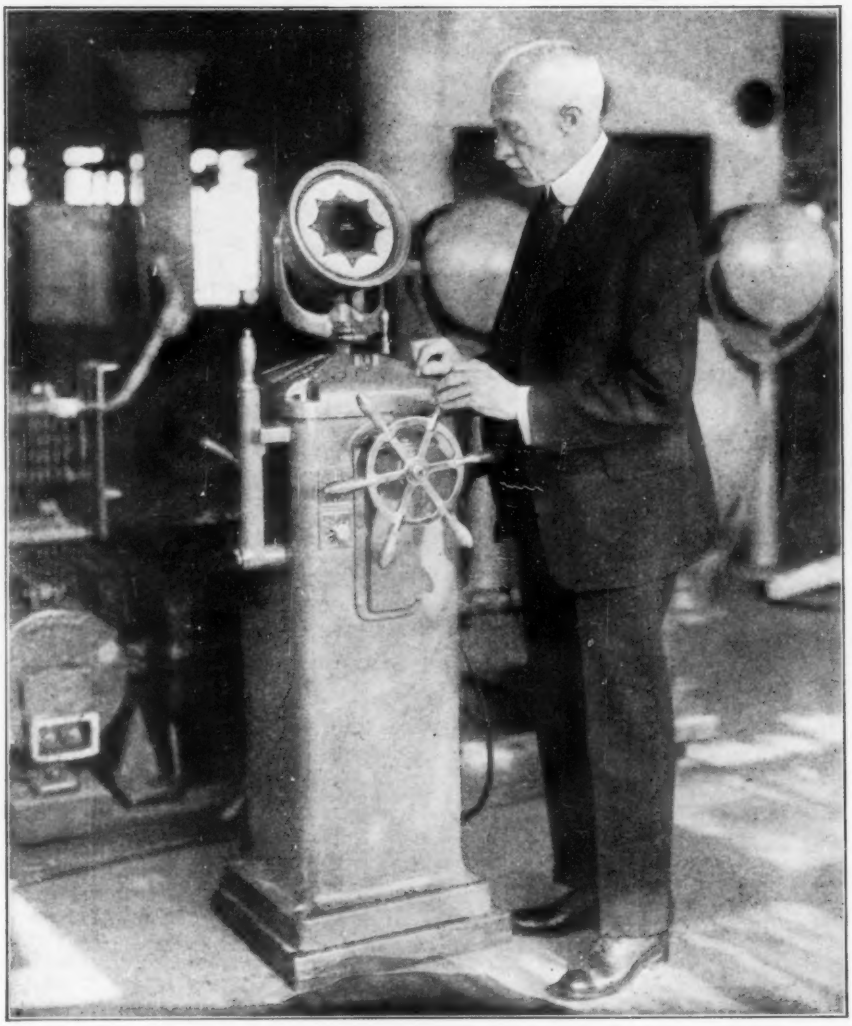
Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles



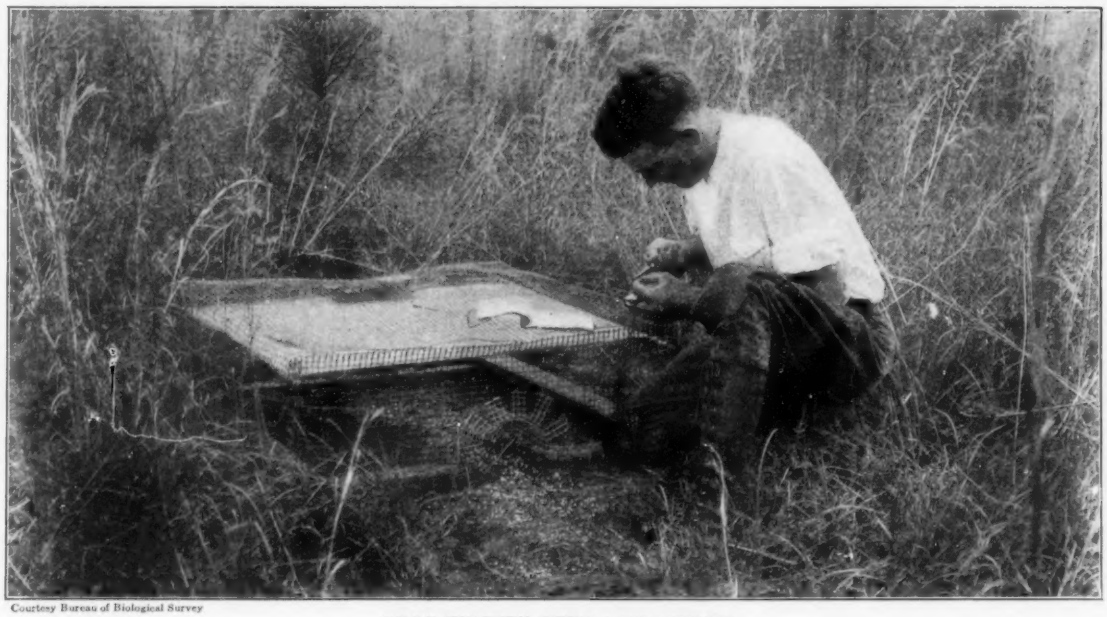
Elmer Sperry

ALTHOUGH Dr. Elmer A. Sperry is perhaps most widely known as the inventor of the gyroscopic compass and gyroscopic stabilizer for ships, he has been the recipient of many different honors in the broad field of engineering, industry and science. Born in western New York in 1860 and educated at Cornell University, he at once began the manufacture of electrical equipment and the development of his inventions, of which he has made more than 400. These pertain largely to naval purposes but include also electric beacons, high-intensity searchlights, the first electric chain mining machine (1888), various electro-chemical processes, machinery for making fuse wires and an electric automobile. Numerous prizes, medals and decorations have been awarded him. He is a member and founder of the American Institute of Electrical Engineers and the American Electrical Society; a member of the American Society of Mechanical Engineers and other engineering and scientific societies. Pure science has recognized him by an award of membership in the National Academy of Sciences. In the picture reproduced above, he is shown standing beside "Metal Mike," the automatic steering apparatus for ships, which he invented. This device is used regularly on many vessels.

Courtesy *Illustrated London News*

Mercury—A Toasted World Where Lead Would Melt

MR. SCRIVEN BOLTON, an English amateur astronomer who is also an artist, has strikingly depicted his conception of a typical landscape on the planet Mercury where the Sun, lying only 35,000,000 miles away and much larger in apparent size than when seen from the Earth, is believed to shine perpetually and relentlessly on the same baked face of the little world. Radiometric measurements of this sunward face, made by Pettit and Nicholson of Mt. Wilson Observatory, who used extremely sensitive apparatus similar to that previously described in the SCIENTIFIC AMERICAN, indicate a temperature of 660 degrees, Fahrenheit. Lead would melt! Surface markings have been detected on Mercury but their permanent, objective existence has never been definitely established. Mercury doubtless lacks, or nearly lacks, an atmosphere. In this it is much like the Moon which it resembles in size. A 150-pound man would weigh only 40½ pounds on the planet Mercury—before he was broiled to a crisp!



Courtesy Bureau of Biological Survey

"BOB WHITE" GETS A BRACELET

Placing a band about the leg of a bird that has just been caught in a trap specially designed for these ground birds. A layer of cloth placed underneath the wire mesh top of the cage prevents the birds from injuring themselves when they dart about trying to escape

Bird Secrets Revealed By Bracelets

Ornithologists Find the Answers to Many Important Questions About Birds By Banding Their Legs

By WALTER E. BURTON

Fascinating Co-operation

BIRD banding has a fascination all its own. As a hobby, it gives the amateur ornithologist much satisfaction to feel that he is helping to solve the question of how pest-birds may be controlled, and of how to protect game and useful birds. But think of the thrill that comes when he learns that a bird he banded has been found in some far-off, exotic clime!

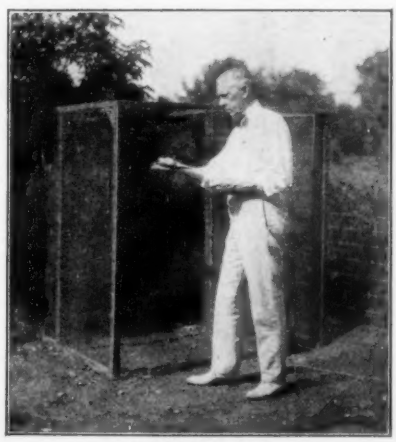
The Bureau of Biological Survey will assist any person over 18 years old who seriously wishes to co-operate in this work. Instructions and serially numbered aluminum bands will be supplied. It is necessary, however, to obtain a license from the Bureau and, in some cases, from one's state government as well.—*The Editor.*

A FEW miles from the city of Cleveland, Ohio, there is a 100-acre farm which is said to contain more birds per acre than any other spot in the United States. This is the bird-banding station of S. Prentiss Baldwin, a business man who has turned ornithologist. He also maintains a similar "laboratory" at Thomasville, Georgia, during winter months.

Mr. Baldwin, a pioneer in modern bird banding, has done perhaps more than any other person to place the capturing, marking, and studying of birds on a scientific footing. His methods of trapping, applying the bands, and keeping records of subsequent captures have been adopted by the United States Biological Survey and by other groups and individuals interested in the work.

ORNITHOLOGISTS both in Europe and America have known for a long time that many important scientific questions pertaining to all phases of bird life could be answered if it were possible to obtain a large mass of accurate information about bird migration and its attendant activities. Until two decades ago, the principal methods by which students attempted to throw light upon migration included observation of day migrants, collection of data concerning the arrival and departure of birds at certain places, and of biological, geological, and meteorological data influencing migration, and the like. Although much was learned from these activities, there was the serious drawback that the information pertained to species and not to individual birds.

The method of bird banding deals with the individual bird, and with birds in large groups as well. The mere banding of a bird is in itself of no value unless that particular bird later is captured. The more frequently it is taken the better. In this way a large amount of information is accumulating, and



A BIRD TRAP

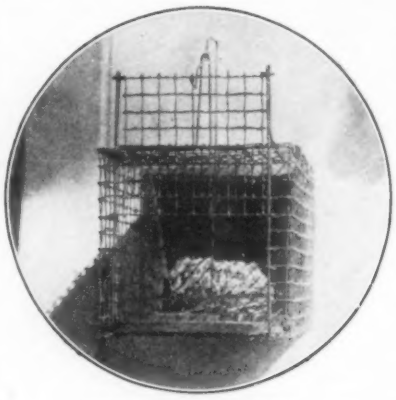
Mr. Baldwin taking a bird from one of his traps. He has handled thousands safely

some day, no doubt, will be the means of providing complete, accurate knowledge concerning the movements of all kinds of birds; the actions of various individuals and species during different seasons; the cause of the enormously high rate of bird mortality; the reasons for shifting migration routes; the proportion of birds which return year after year to their former meeting places; and many other perplexing problems which will lead to a better understanding of our friends of the air when properly answered. Such knowledge, aside from its purely scientific value, already is showing in a practical way how migratory birds can be protected and how their usefulness as insect-destroyers can be maintained and increased.

THESE are but a few of the problems which ornithologists hope to solve by means of bird banding, according to Mr. Baldwin. The answers to some are being obtained slowly, while the solution of others will come only after many years of bird banding, with thousands of persons co-operating.

For example, the common crow presents a problem on which these bird-banding studies are beginning to cast a light. Sometimes crows are responsible for serious damage and must be controlled. Here a knowledge of their food habits and the periodic movements of individuals is required. Winter is the season in which they are most easily destroyed. Then it becomes important to know whether the individuals that make up the large winter roosts are the same as those guilty of depredations on crops of the locality in the summer. Only after many more recoveries will it be possible to know whether winter slaughter will protect the crops of the following season, or whether it will merely cut down the number of crows that would otherwise scatter to other localities in which their good habits outweigh their destructiveness.

In the year 1710, a big, gray heron was captured in Germany. On one of its legs were several metal rings, one of them bearing an inscription which



ROBIN NEST TRAP

The weight of the bird on the nest operates a mechanism which drops the sliding door

stated that the bird had been caught in Turkey several years before. This, the first recorded instance of bird banding, caused a little local comment perhaps, and then was forgotten.

A hundred years later Brugmann, a Dutch naturalist, began to wonder about the winter activities of Holland's many storks. He captured a few of the lanky birds, placed rings about their legs, and then released them. He never saw his marked birds again, and concluded that they select a different home each summer.

At the end of the nineteenth century Mortensen, a Dane, captured and banded a number of birds of different species. He succeeded in recapturing many of them, thereby arousing the interest of other ornithologists. The practice of banding birds then began to spread, but was temporarily halted by the World War. Scientific bird banding began in the United States when Leon J. Cole, of New York, founded the American Bird Banding Association in 1909.

One phase of early banding operations prevented the science from gaining wide popularity. It was necessary to kill the marked birds in order to recapture them and read the inscriptions on their bands. Mr. Baldwin, by devising several satisfactory types of bird traps, eliminated this drawback and brought about a complete revolution in banding methods.

"THE question is still frequently asked, whether bird-banding methods are cruel or harmful to the birds," Mr. Baldwin says. "Such questions can be answered best by explaining that every banding station becomes, in fact, a bird sanctuary. Here food and shelter, as well as safety from natural enemies, can be obtained. In fact, many birds regard a trap as a kind of cafeteria, and return hundreds of times during a season.

"There have been so few serious accidents to birds in my traps, or to the thousands which I have handled each year, that I can remember every fatality that has occurred in the many years of my experience. Such accidents have not averaged two a year—less than one accident to every thousand birds handled.

"It is one of the joys of this work that the ornithologist may handle and study great numbers of birds in a live, healthy condition, in normal colors not affected by the changes which come so quickly after death, and may make normal measurements and study natural attitudes and individual characteristics—all without destruction of a single life. For every dozen accidents that I have had with birds, I have been able to save actually hundreds of lives by proper care."

Courtesy Bureau of Biological Survey

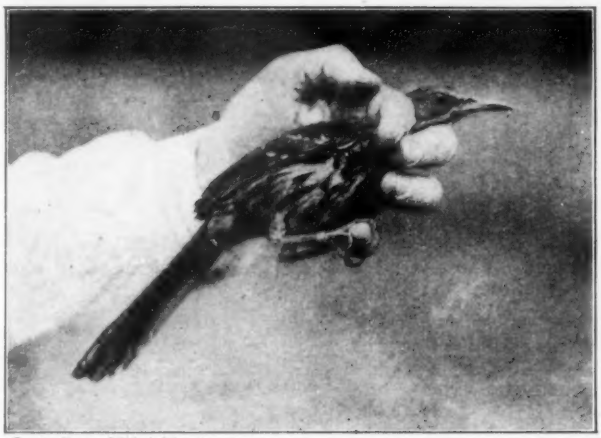
BANDING A DUCK

A duck submits quietly to the process of being banded. Very large birds, such as eagles, require the undivided attention of several men

Courtesy Bureau of Biological Survey

HERRING GULLS

Placing aluminum bands on the legs of a large number of these birds captured off Hat Island, Michigan. It is fascinating outdoor work



Courtesy Bureau of Biological Survey

BEST POSITION FOR READING THE BAND

This position has proved most satisfactory for reading a band or inspecting the bird's markings. This brown thrasher rests quietly

HOLDING A BIRD FOR BANDING

By holding the bird in this manner, the thumb and forefinger are free enough to steady the leg. This mourning dove has already been banded

Much light has been thrown by bird banding upon the mystery of bird migration. One of the most unusual records is that of a common tern which was found floating on the Niger river in western Africa. On one of its legs was a band which had been placed there at a banding station in Maine!

A number of wild ducks were banded in Canada one fall. During the following few weeks many of them fell before hunters' guns. Reports of the various captures revealed that the birds, in their journey south, had taken two distinct routes, one along the Atlantic coast and the other down through the Mississippi valley. The last of the ducks was captured in far-off Trinidad, off the northeastern coast of South America.

THE direction of migration was for a long time a subject of much controversy. From casual observation of bird flight a theory that some species of birds migrated east and west, rather than north and south, was developed in North America and in Europe. In recent years, banding activities have shown that this theory is correct. For example, it is known that the marbled godwit of North America moves both east and west from its breeding ground, and that the thick-billed sparrow travels southeast, southwest and northwest from its breeding place. Ducks banded at Great Salt Lake, Utah, were found to migrate towards the four major points of the compass. Similarly, European woodcocks caught and banded at St. Petersburg, Russia, (now Leningrad) flew to three widely-separated winter quarters.

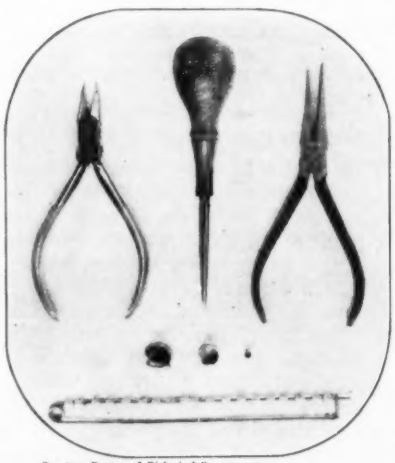
Many instances of extremely long bird flights are on record. For example, there is the arctic tern, the present record-holder of bird distance records. Each year it wings its way for 11,000 miles from antarctic ice fields to a nesting place not far from the North Pole. Several weeks later it returns south with the sun. The non-stop record among birds is held by a little warbler, not much larger than a man's thumb, which speeds over the Atlantic ocean from Nova Scotia to the Lesser Antilles on the northeast coast of South America, a distance of about 2500 miles.

Mr. Baldwin has made a more intensive study of the house wren than of any other bird, largely because this bird is easily handled. On his farm, a wren has absolutely no privacy. Each wren egg, as soon as it is laid, is marked, measured, and weighed. These measurements are repeated from day to day during the incubation period.

As soon as the baby wren finds itself in the world outside the shell, it is given a number corresponding to that of the egg from which it emerged. This number is marked on its beak where it remains until the bird is old enough to wear a tiny aluminum bracelet. The growing bird is weighed daily, and careful watch is kept constantly for any peculiarities worth noting.

Mr. Baldwin, in studying the wren, found it necessary to keep a constant record of the movements of the mother bird during the period of incubation. To accomplish this, he placed a delicate thermo-couple in the nest among the eggs. This was connected to a recording drum. When the temperature of the nest was raised by the presence of the mother wren or lowered by her departure, the fact was recorded on the drum in a continuous, wavy line.

Other important facts about wrens were unearthed by banding. It was learned that they make their winter home in Central America, and that they often return to the same summer home for several consecutive seasons.



Courtesy Bureau of Biological Survey

BANDING EQUIPMENT

Pliers, band spreader, several sizes of bands, and the "safety pin" band holder

BIRDS, like human beings, suffer from various kinds of ills, Mr. Baldwin has found. At his Thomasville station many chirping sparrows with diseased feet were caught. A nail or part of a toe would be missing, or an ugly, black sore would be present on a toe or foot. In some cases the feet would be bleeding badly. Occasionally a bird with an entire foot rotting away would be found, while other captives bore evidence, in the form of large scars, that they had suffered from the disease and then recovered.

Bird banding has a considerable economic value. It enables us to learn how to protect the wild birds which in turn devour crop-destroying insects. If there were no birds in the United States it would be only a matter of time until insects would threaten the food supply of the nation. It is only through activities of many banders, scattered throughout the country, that the movement will make rapid progress. If you find a bird, dead or alive, wearing a tiny aluminum bracelet, inform the United States Biological Survey of the fact, giving the number of the band, the kind of bird, place found, peculiarities, if any, and the like. In forwarding this information, you will be performing a valuable service for an important cause.

Our Point

Whose Responsibility?

DEATH, almost as certain as ultimate death, rapidly approaches the doorstep of five women in Orange, New Jersey. The women are condemned to lingering pain, suffering, then extinction. The cause—radium poisoning. Three of the five are married. One has two young children. Another has had two children, stillborn. Science is impotent, medicine surrenders, radioactivity obeys relentlessly the blind laws of nature, death approaches.

Eleven years ago the story begins. Girls, jovial, light-hearted, sit in the factory of the United States Radium Corporation at Orange, doing piece work on watch dials, painting over the numerals with the radioactive stuff that enables you and us to see the time in the dark. They like their work.

The luminous preparation they apply so deftly is crystalline zinc sulfide with a dab of radium or mesothorium sulfate, mixed with gum arabic to make it stick. Radioactive material costs money, therefore it must not be wasted. The girls, in order to conserve it, pointed the tips of the brushes between their lips.

Since then we believe 13 of these girls have died.

Radium necrosis is the name of the sinister disease caused as a result of absorbing too much radioactive material in the body. Necrosis means "dead"—the bones die; other parts are affected. Of all the parts of the body the blood making apparatus, contained in the bones, seems to be the most sensitive to radioactivity. The insidious thing about this disease is that it lies latent for several years. Its causes are cumulative. Thus, by the time the light hearted girls discovered its first inroads all had left the work; some had married.

Who is to blame in a case like this? Who should pay? There are two sides to the matter, the legal side and the human side. The former aspect has been attended to. Under pressure of wise legal counsel, public opinion, conscience perhaps partly triumphant over stubborness, the former employers have agreed to award—so it is stated—each victim 10,000 dollars outright and 600 dollars yearly during life; also medical costs. So much for the legal side.

But in a larger sense, who is to blame for the horrible blunder? Surely the girls were not. Are the employers? Years ago they should have heeded the warnings of general scientific information. Evidently they took these warnings with a large grain of salt. The knowledge of the wrong they did thereby will ever be their cross to bear. Perhaps it is a case where the greatest share of responsibility is no one's. A new field—radioactivity—was being explored; still is, in fact. Man blundered into a pitfall. He creates many engines which he has not learned fully to control.

Rejuvenation

VORONOFF, the Paris surgeon who performed gland grafting experiments on animals with a view to rejuvenation, recently has been investigated again. A British delegation of scientists visited the Voronoff experimental farm in Algeria and rendered the opinion that, while the evidences of rejuvenation provided by the famous bull "Jacky" support Voronoff's hypothesis, they cannot be accepted as final proof. The other experiments observed were not, in the opinion of the delegation, carried out in a thoroughly scientific manner.

As yet Voronoff, with his gland-grafting operation, has made very little headway in convincing science of the worth of his method. Steinach, who transplants nothing, but merely ties off a duct, has received much more favorable notice, largely it is true because he has conducted his experiments in a more disciplined, scientific manner than Voronoff.

Neither Voronoff nor Steinach has yet received in large measure the approval of science.

Will the Railroads Buy Wings?

TWO trends, one already taking place, the other placeable in the future, are likely to have robbed the railroads of all but a fraction of their passenger traffic before another decade has rolled around.

Since 1920, although the nation has increased approximately 13 percent in population, there has been a decline in passenger traffic of about one third—so we are told by Ralph Budd, president of the Great Northern. This is attributable to the private automobile and more recently the motor coach. In the west the decline has been even more notable than these startling statements would imply, the number of passengers carried being only one half as large in 1927 as in 1920; and if one isolates the figures for a single state like Minnesota the corresponding reduction is two thirds. How will the loss of passenger revenue be allocated? Obviously to freight.

Mr. Budd goes on to point out that the trend is now toward the highway for local travel, while the long journeys continue to be made by rail. But do we now espy on the distant horizon the competitor who is destined also to take away a share of the remaining long distance passenger hauling? What of the airplane now coming on apace? How much longer will "the long journey continue to be made by rail?"

It is easy to wave aside the risky airplane as a serious future competitor with the railroads for average passengers, yet there was a time when stage coach owners similarly waved aside the "dangerous" railroads. Already the predicted wedge is entering. Overland journeys are soon to be made alternately by rail (at night) and by airplane (in daylight), the entire coast-to-coast journey thus being cut to 48 hours. How much longer will it be at the present rate of progress in commercial aviation before the entire journey will regularly be accomplished in a single leap, and with no more thought of the unusual than that which is now involved in taking a transcontinental express. To derive the answer, think back to the status of civilian aviation 10 years ago and then project a comparable progress into the future. Gigantic, undreamed of strides are inevitable.

Some of the railroads have displayed enough vision to get into the bus business before others should beat them to it. How will they be able to avoid embracing aviation in the same manner?

Specialization

A HIGH school youth recently wrote asking us to advise him the best subject in electrical engineering in which he should specialize. Naturally we couldn't, for, aside from the fact that we had no way of knowing either his particular aptitudes or anything about his individual nature, specialization should come only after years of study of a subject as a whole and a great deal of practical experience.

We are not so sure but that there is already too much early specialization. Too often a youth selects his subject

# of View

when he is so young that neither he nor his parents and teachers have any idea what suits him best. His background of fundamentals may be poor in respect to the particular knowledge necessary for the attainment of his goal. Or his personality, propensities, traditions, all may combine to thwart him. The country is full of persons who either are misfits in their chosen professions, and consequently will never pass mediocrity, or have given them up entirely for something else, the simplest rudiments of which must still be learned at an advanced age.

In answer to such questions as that mentioned above, therefore, we should like to point to the medical profession as a standard. In this there are few misfits, and cases where a medical graduate has turned to some other work are extremely rare. Specialization comes only after completion of a broad and full college course, a three-year to six-year medical school course, and a period of a year or two as a hospital interne.

Of course it would be impossible to follow this procedure in some professions, literally at least, but we should like to see it applied to some extent in a great many. Too early specialization may result in mediocrity, and no one likes even to see much of that.

Golf!

NEWS item: "Golf for workingmen at a cost of 25 cents for green fees, one dollar each for clubs and 15 cents each for balls has been inaugurated by George F. Johnson, shoe manufacturer of Binghamton, New York. . . . Golfing costumes will be discouraged, players being urged to play in their ordinary clothes. The company will furnish free golf shoes to all employees."

And as the golf season is with us, the wail goes up from the editorial sanctums, "Why, oh, why did we not become shoemakers!"

Street Gases

A WAVE of hysteria concerning the danger of poisoning of city-dwellers by automobile exhaust gases has been sweeping the country for some months past. Carbon monoxide gas, product of incomplete combustion, which prevents delivery of oxygen to the tissues of the body by combining with the haemoglobin of the blood, has been cited most often as the chief source of danger.

The United States Public Health Service has just completed a survey in which 250 samples of air were taken and tested from 14 large cities totalling 19,000,000 population. "The average of 141 tests made in city streets during peak traffic hours showed a contamination of 0.8 of one part in 10,000," says the report. "Only 24 percent of all street samples showed more than one part in 10,000, and in only one place, a covered passageway, was there as much as two parts in 10,000. Samples taken inside buses yielded even lower concentrations."

A person can breathe an atmosphere containing four parts in 10,000 for several hours with only a resulting headache and some discomfort, while it takes a concentration as high as three parts in 1000 to produce unconsciousness in 25 to 30 minutes and even this is not necessarily fatal if the victim is immediately removed to fresh air. From this it can be seen that the carbon monoxide exhausted from automobiles in our city streets presents no real health hazard.

Higher concentrations were found in garages, however, by the Public Health Service. There is a definite danger in letting a motor run for a short time in a roofed enclosure, and every car owner is warned not to let his car run and exhaust its gases in a closed garage longer than is absolutely necessary when driving in or out.

Airplane Radio

RECENTLY, at the time of writing, the value of radio to the aerial navigator has been vividly demonstrated. By use of it, the *Southern Cross* was in constant touch with civilization throughout its long transpacific flight, and the tragic fate of Nobile's dirigible *Italia* soon was learned and rescue parties dispatched. True, the now historic *Spirit of St. Louis* flew thousands of miles, much of the time out of sight of land, and came through safely without the use of radio.

But the value of communication between aircraft and ground cannot be disputed. By means of it, the radio compass can be used to guide the pilot through the heaviest fog, and so aid in breaking the grip of the greatest enemy of the flyer; the pilot can be informed of approaching storms; and in passenger planes, the passengers can carry on their business correspondence with as much ease as if on board a palatial ocean liner.

The value of radio to the passenger-carrying steamship has been shown time and again, and laws are in effect that require the installation of radio apparatus on such vessels. Why cannot the same regulations be applied to aircraft that are used for passenger transportation? The usefulness of radio is being demonstrated every day by the planes flying to and from the huge airdrome in Croydon, England.

Let us look forward to a greater development of aircraft radio, and to the many benefits that it will bring.

"Talking Movies"

EVIDENTLY the "talking movie" is with us to stay. A research branch of the Western Electric Company has recently announced that contracts have been completed which mean that the major motion-picture producers in the country will adopt one form or other of talking movies for use in their studios. This will mean that a great impetus will necessarily be given to the installation of special projection apparatus in theaters. The two main systems of taking and reproducing talking movies, Vitaphone and Movietone, have been described in this magazine. (June and September, 1927.)

Just how far the "talking" part will go in the composition of future motion pictures, still remains to be seen. As a means of presenting a complete synchronized musical score for the picture, the present systems leave little to be desired. When used in this way, the talking movie brings to the small theater the reproduction of large orchestras, without the expense.

But deliver us from the speaking voice of some of the present-day motion picture stars! What a sad disillusionment it is to see the sweet face and actions of a popular star, only to hear the coarse, harsh voice of the forewoman of the local hat factory when she speaks. Will the advent of the talking movie mean that a new set of stars will rise in the firmament of moviedom? Or will "ghost talkers" spring up in the industry, just as "ghost writers" have become so popular in current writing?

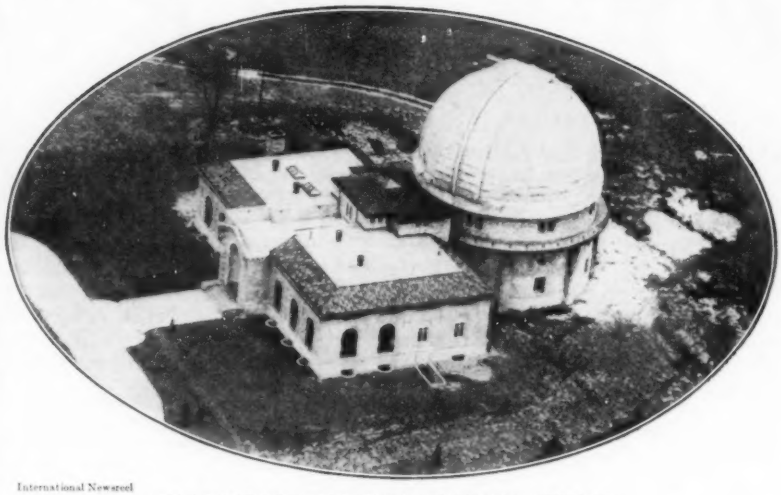
In any event, the end of 1928 should answer these questions, for it is predicted that by then there will be at least 1000 theaters equipped for presenting talking movies.

From the Scrap-book of Science—

F and A

NEW TRACTOR RECORD

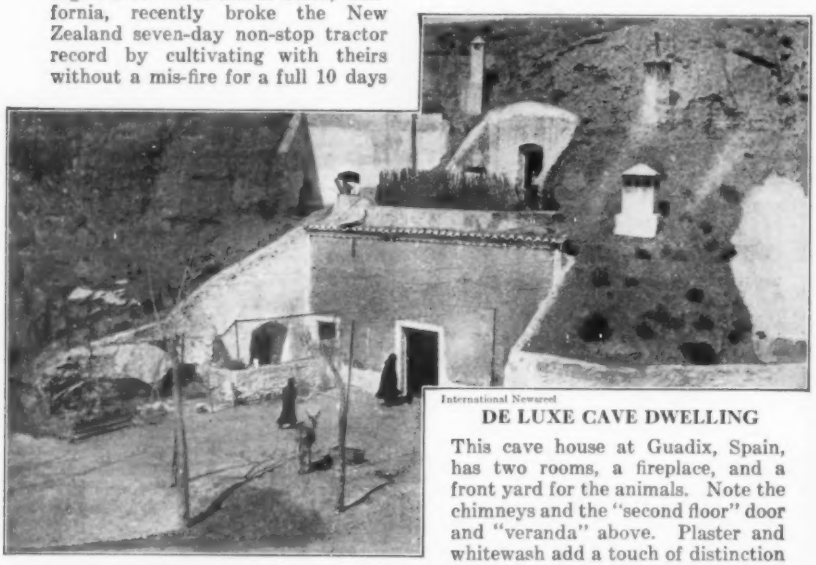
Working in 12-hour shifts, the Battaglia brothers of Santa Clara, California, recently broke the New Zealand seven-day non-stop tractor record by cultivating with theirs without a mis-fire for a full 10 days



International Newsreel

FOR WORLD'S THIRD LARGEST TELESCOPE

Perkins Observatory, Ohio Wesleyan University. Here will be housed the world's third largest telescope which was given by Mr. and Mrs. Hiram Perkins. The Bureau of Standards cast the mirror—the largest American-made optical glass. Mirror diameter, 61 inches; weight, a ton and a half



International Newsreel

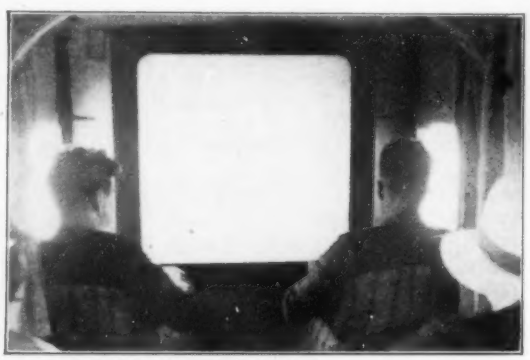
DE LUXE CAVE DWELLING

This cave house at Guadix, Spain, has two rooms, a fireplace, and a front yard for the animals. Note the chimneys and the "second floor" door and "veranda" above. Plaster and whitewash add a touch of distinction

Underwood and Underwood

GAS-PROOF UNIFORM

Ordnance officers of the United States Army have just given this new uniform a series of thorough tests. It not only protects the wearer from poisonous gases that attack the lungs but also from gases, such as mustard gas, which do their deadly duty by burning the flesh severely, thus rendering the combatant *hors de combat*. In this, the gas mask is supplemented by overalls, and gloves and boots of treated fabric which strap tightly to the wrists and ankles



F and A

"MOVIES" FOR AIR PASSENGERS

The Maddux Air Lines of Los Angeles recently projected a five-reel comedy in one of its planes while en route. The results were so good that the practice will be continued. Photographs show the projectionist and the motion-picture screen

Camera Shots of Scientific Events

P and A

SEWING MACHINES IN THE EVERGLADES

Gone are many of the ancestral customs of the Seminole Indians of the Everglades in Florida, but they stick to their colorful garments. Now, however, they use a modern sewing machine instead of old slow hand methods

P and A

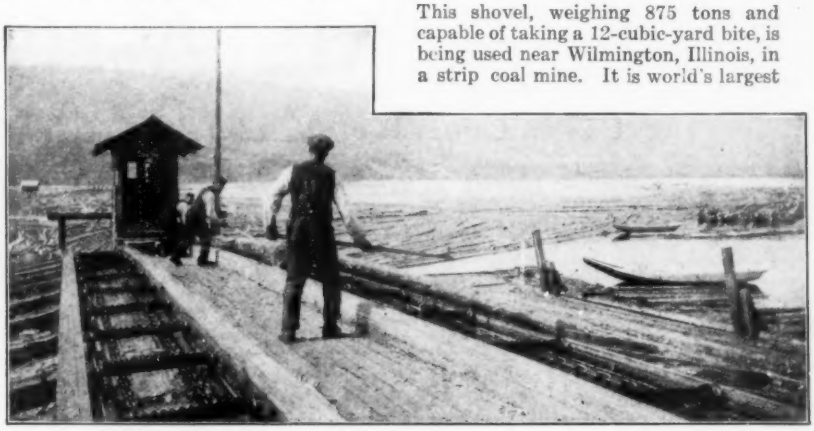
GIGANTIC ELECTRIC SHOVEL

This shovel, weighing 875 tons and capable of taking a 12-cubic-yard bite, is being used near Wilmington, Illinois, in a strip coal mine. It is world's largest

P and A

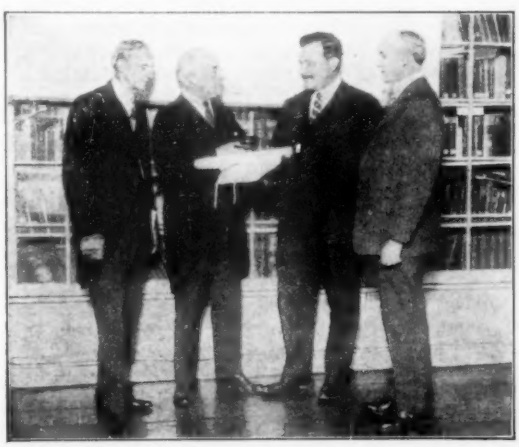
CURB MAIL BOX

To relieve double parking of cars by persons who stop merely to post a letter, this mail box has been placed at the curb before the Oakland, California, post office. Extra height and a long handle to the slot cover add to the convenience of this courtesy box



RAFT MAKING

The wood pulp industry in Norway uses this method of making log-rafts. After sorting, the logs are carried by an endless chain to a point where they are pushed off and bound together with wire cables for the trip down a waterway to a port on the seacoast



CRESSON MEDALS

At a luncheon given recently in their honor, prominent industrialists, scientists, and inventors were presented with Cresson Medals by The Franklin Institute. The photograph shows from left to right: Henry Ford; Dr. Howard McClenahan, Secretary of The Franklin Institute; Charles L. Lawrance, the designer of the Wright Whirlwind motor which has made possible many record airplane flights; and Orville Wright, pioneer airman

Wide World

Wide World

AUTOMATIC DIALING DEVICE

Santos Pastor has just invented this device which eliminates the necessity of dialing a telephone connection through a central office. Regulated to secure 10 numbers by touching a button, it can be used to connect banks, et cetera, with their branch offices quickly

Painted under the direction of Henry Fairfield Osborn by Charles R. Knight. Courtesy American Museum of Natural History

CAVE MAN OF THE NEANDERTHAL RACE, LE MOUSTIER CAVERN

Le Moustier Cavern is on the cliffs of the Vézère in France. The artifacts found in this cave were so representative of those of Neanderthal man that the term "Mousterian" was applied to the known period of his existence, dated by many from 150,000 down to 25,000 years ago

Neanderthal Man *Not* Our Ancestor

An Early Controversy, Once Apparently Settled, Has Been Revived By a Recent Utterance

By G. ELLIOT SMITH, M.D., D.Sc., Litt.D.
Professor of Anatomy, University of London
Fellow of the Royal Society

IT has taken many years of discussion to make clear to some—although not all—of our critics that those of us who believe the human family to be descended from the anthropoid apes do not regard the gorilla or chimpanzee as our ancestor, but merely as a collateral descendant of the same original, although very remote, ancestral stock.

In other words, several million years ago the descendants of one group of the anthropoid apes, nearly akin to the fossil known as *Dryopithecus* (from the Miocene epoch beds of India) became separated into two groups, one of which, in the course of a million years or so, became gradually transformed into men, the other into chimpanzees and gorillas.

BUT the Miocene ancestor was neither a man nor a chimpanzee. Hence it would be absurd to say that man was the offspring of a chimpanzee, when the evidence is so clear that both were developing simultaneously from some much more ancient ape.

Much of the same sort of confusion has arisen with reference to the weird type of extinct members of the human family known to us (by the fossils that have been found from 1848 onwards) under the name "Neanderthal man," because the first example of this strange sort of creature to attract the attention of scientific men was found at Neanderthal in 1856, although not made known to the public until the following year.

Most anatomists are now agreed that the living races of men are not descendants of Neanderthal man, but that the latter was a collateral branch of the human family, so specialized in structure as to belong to a species altogether distinct from that to which all modern men belong.

Courtesy A.M.N.H., after Boule

LA CHAPELLE-AUX-SAINTS SKULL

The skeleton was found, almost complete, in a grotto near Le Moustier, in 1908

Dr. Hrdlicka has revived the speculation that Neanderthal man is our ancestor. Perhaps it will be helpful if I set forth my reasons for disagreeing with his suggestion.

THE year 1857 witnessed the opening of a new chapter in the history of the human family. The public announcement of the discovery of remains of a strangely exotic type of man found near the entrance to a limestone cave in the Neanderthal between Düsseldorf and Elberfeld (in Rhenish Prussia) raised a controversy. It was, in fact, the first time that scientists were faced with the problem of the possibility that formerly there were men who did not belong to the species which includes all living men.

When the fossilized skull was first exhibited at a meeting of German scientists at Bonn, many of them freely expressed their doubts as to whether it was human, and not that of some extinct monster. Dr. Schaaffhausen, however, was convinced of its real significance, for he referred to the fact

that the extraordinary form of the skull was due to a natural conformation hitherto not known to exist, even in the most barbarous races.

He had no doubt of its being a human relic which could be referred back to a more remote period, long before that of any of the living races of Europe, when animals such as mastodons, cave bears, rhinoceroses and other creatures long since extinct were roaming about Europe.

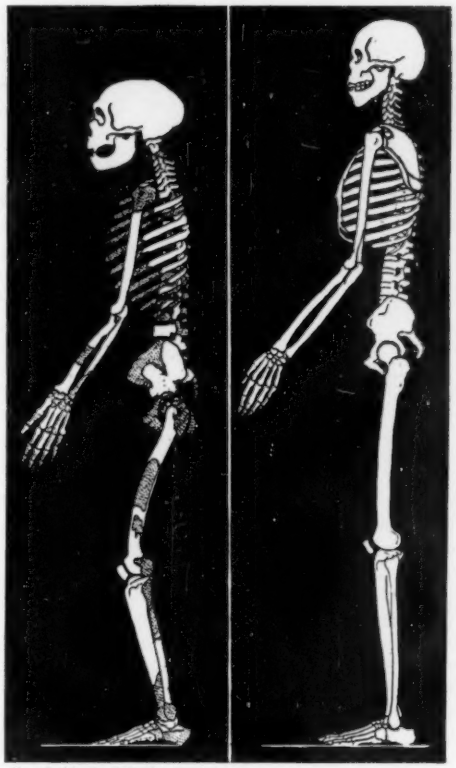
But these views were not welcomed by the majority of his scientific colleagues, for after a short time those who did not believe the fossil to be a part of some extinct animal that was not human, attempted to explain its peculiar features as due to some pathological process. This interpretation was urged with more emphasis by the famous pathologist Virchow. These facts are sufficient to emphasize the consideration that the original fossil differed profoundly from any other known human remains.

IN the year 1860 Sir Charles Lyell visited the site of the discovery and examined the original fossil skull. Moreover, he obtained from its discoverer a cast of it, which he brought back to England for Huxley to examine, so as to prepare for the new edition of his (Lyell's) book *"The Antiquity of Man"* a reliable report of this significant discovery. Huxley at once remarked that it was the most ape-like skull he had ever seen. He also admitted that the difference between it and the other fossil skulls which had been found in Europe was so vast, and the flattening so prodigious, that he imagined he must have fallen into some error in making his measurements. It is then quite clear, however, that it was merely an excess of caution which impelled him to refuse to regard it as an extinct species of the human family.

It must not be forgotten that this happened a few months after the publication of Charles Darwin's "Origin of Species," which created a tremendous sensation. Huxley was not only the leading champion of the cause of evolution, but he was also anxious to secure the support of Sir Charles Lyell. In the fierce conflict in which he became involved he took exceptional pains to avoid any statement that he could not justify to his own complete satisfaction.

In trying to put ourselves in the position that Huxley was in in 1860, it must not be forgotten that at that time no human remains, either ancient or modern, had yet been found that did not belong to the same species as ours, that is, *Homo sapiens*. Moreover, Huxley admitted that in the absence of a jaw, which might afford decisive evidence, and in view of the conflict that was raging between those who denied that it was human, and the others who considered it merely a pathological specimen, he was constrained to take the middle course, and assume it to be simply a primitive member of our own species. Huxley clearly did not consider Neanderthal man as the ancestor of any modern race of men.

In 1886, however, an important discovery of two skulls of the same type was made at Spy in Belgium, and this event had far-reaching consequences. Not only did the discovery of the two heads (displaying the same remarkable features) destroy once for all the pathological theory put forward by Virchow, but the chinless jaws afforded evidence, the lack of which 26 years earlier had, on his own admission, swayed Huxley's judgment as to the extent of the gap that separated Neanderthal man from modern man.



From Boule's "Fossil Men," by permission

A STRIKING CONTRAST

Left: *Skeleton of Neanderthaloid man of La Chapelle-aux-Saints.* Right: *An Australian; same scale*

WHAT was even more significant was the association of the two Belgian fossils with the remains of extinct animals (such as the mastodons, cave bears, and so on) and implements tens of thousands of years old, thus establishing the fact that these grotesque men were living in Europe at a time in comparison with which men of our own type seem to be quite modern.

In spite of these facts, however, and complete elimination both of the pathological and of the non-human theories of origin, scientific opinion did not become crystallized until the year 1900, when Professor Schwalbe of Strassburg made a detailed comparison of the form and measurements of the Neanderthal group of men, and proved to the satisfaction of most anatomists that the differences between Neanderthal man and modern man were so profound as to demand as an adequate expression of their magnitude the creation of a new species distinct from *sapiens*. This proposal had been made as long ago as 1864 by Professor William King of Galway, but he was unable to establish his claim in opposition to the cautious Huxley. Nor again was the distinction admitted when the Gibraltar skull, the first representative of Neanderthal man, which had been discovered as long ago as 1848, was brought to London in 1868 and described as a new species with the name *calficus*, by Falconer.

After Schwalbe's important demonstration of the distinctive traits of Neanderthal man, fresh evidence was forthcoming that not only established the justice of his claims, but also proved that this peculiar type of mankind had in certain respects become so highly specialized as to make it impossible to regard him as the ancestor of men of our own type.

THE ORIGINAL NEANDERTHAL SKULL

Found in a cave in the Neanderthal Valley in Germany, in 1856. Note the heavy eyebrow ridges and the low outline

FROM 1899 onwards for several years a vast number of fragments, mainly of jaws and teeth, were found near Krapina, in what is now known as Jugo-Slavia. It was shown by comparison of a large number of these teeth that they had become modified in a very peculiar and distinctive way, their pulp cavities becoming enormously enlarged, and the roots correspondingly reduced in length—so as

Courtesy A.M.N.H.

THE SPY I SKULL

One of two later Neanderthal types found in a grotto near Spy, Belgium, in 1887

to form a type of tooth which differed from those of modern man almost as much as they differed from those of apes. This fact alone was sufficient to demonstrate that the ancestors of Neanderthal man must have already departed widely from the stem which gave rise to members of our own species. In other words, Neanderthal man himself could not by any possibility have been an ancestor of modern man.

In 1908 and the succeeding years, evidence of the utmost importance was obtained in the Dordogne Valley in France, which for most anatomists settled the issue once for all. The most complete skeletons of men of the Neanderthal type that had yet been found were obtained at La Chapelle-Aux-Saints and La Ferrassie, which came under the charge of Professor Boule of the Natural History Museum in Paris, who has written a series of illuminating reports and a book on fossil men.

NEANDERTHAL man is now revealed to us as a type differing profoundly from modern man—an uncouth type with enormous flattened head, very prominent eyebrow ridges and coarse face; the trunk is short and thick; the lower limbs are also short and thick-set. The broad and stooping shoulders lead by a curve to the forwardedly projected head set on an abnormally thick neck. The hands are large and coarse and lack the delicate play between the thumb and fingers that is found in modern man. The nose is not sharply separated from the face, the two being merged into what in another animal would be called a snout. The large brain is singularly defective in the region of the forehead, and one is bound to draw the inference that Neanderthal man's hands and brain were incapable of performing those delicately skilled movements that are a distinctive prerogative of *Homo sapiens*, and the chief means whereby the latter has learned by experiment to interpret and understand the world around him. By such means he acquired the high powers of discrimination that enabled him to replace Neanderthal man, whose brutal strength could not save him from extinction in competition with his more nimble-witted successors.

PROFESSOR BOULE'S investigations have shown that in every part of the body Neanderthal man revealed features that form a profound contrast to those of modern man. I have already referred to the peculiar features of the skull, face, and the chinless jaw. In the region of the thick neck the bones of the spine, instead of sloping downwards as they do in modern man, project horizontally backwards as they do in the chimpanzee and gorilla. In fact these parts of the spine differ so much from those of modern man that in many respects they were much nearer in form to those of the apes.

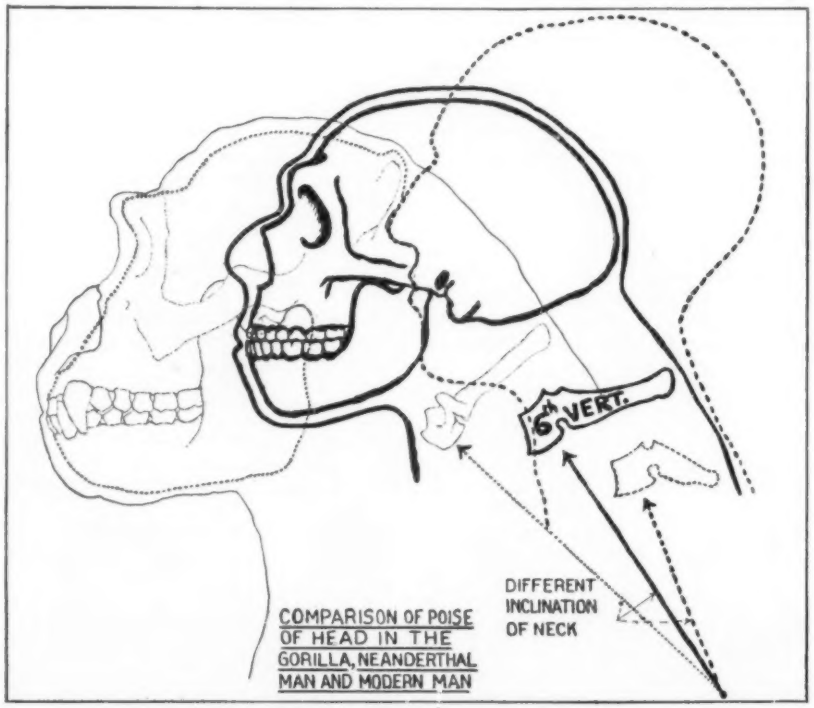
In the accompanying diagram I have attempted to indicate the contrast in form in the neck vertebrae (the sixth alone is shown) of Neanderthal man, in comparison with these of the gorilla and modern man, in order to suggest that, measured by the contrast between modern man and the ape, Neanderthal man differs profoundly from his successor. This is indicated also in the poise of the head, which (for the purposes of the diagram) was determined by the slope of the flow of the brain-case.

The distinctive features of the hands have been commented on previously. In all the bones of the arm similar differences can be detected. The thigh bones, the leg bones, and especially the feet, reveal the most profound contrasts, which have been discussed and interpreted with great lucidity by Dr. Dudley J. Morton in *Natural History*, (1926, page 310) published by the American Museum of Natural History, New York. This gives a very clear explanation of the peculiar features of the foot of Neanderthal man, and its points of resemblance to the foot of the gorilla. In his book on "Fossil Man," Professor Boule has also explained the differences between the feet of Neanderthal and modern man.

The sum total of all of these researches has been to emphasize the consideration that in every part of the body Neanderthal man forms so profound a contrast to the type of modern man as to make it impossible to regard him as a possible ancestor.

LATER on in this article I shall explain how Dr. Morant has recently examined this problem by statistical methods, and has arrived at the conclusion that there is a profound hiatus between Neanderthal man, which exhibits a remarkable uniformity of type, and all the modern races of man, which can only be properly expressed by putting the two groups into different species.

In former years, from the time of Huxley up till modern times, when Professor Sollas of Oxford has revived



NEANDERTHAL MAN NOT OUR ANCESTOR

Neanderthal man differs profoundly from modern man. The author's diagram shows how different are the sixth vertebrae of the three types of primates. Study comparatively each detail

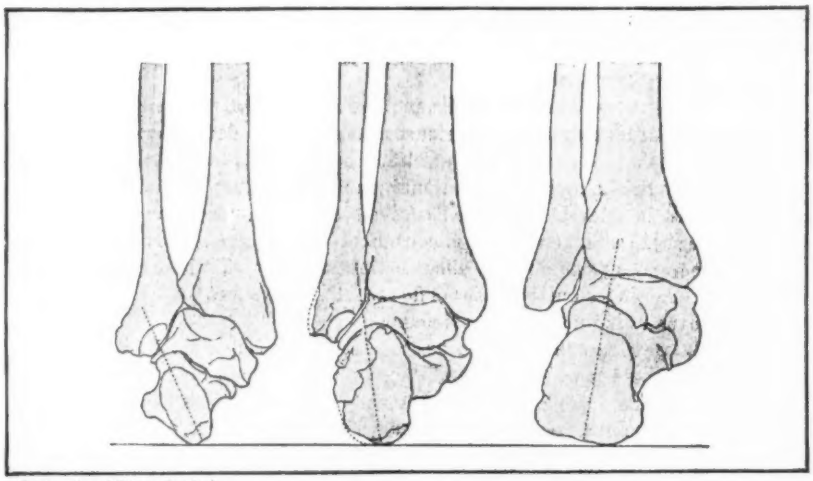
the discussion, many writers have been inclined to insist upon the likeness of Neanderthal man to the aboriginal Australian people; but there are many fundamental points of difference between them, and in spite of his primitive traits the aboriginal Australian conforms to the distinctive features of *Homo sapiens*. Dr. Morant confirms this by means of his statistical methods, and has arrived at the conclusion that although some modern races resemble Neanderthal man more closely than others, no race or group of races can be regarded as akin to those of the extinct fossil type. In other words, the statistical method has confirmed the opinion based upon the anatomical study, that Neanderthal man is widely separated from all living races of mankind, and cannot possibly have been an ancestor of any one of them.

MOST anatomists who have given serious attention to this matter agree in this conclusion, as will be evident to any reader who compares the accounts given in "Ancient Hunters," by Professor Sollas of Oxford, "Men of the Old Stone Age," by Professor Henry Fairfield Osborn of the American Museum of Natural History, "The Antiquity of Man," by Sir Arthur Keith, "Fossil Men," by Professor Boule and the many others who in recent years have investigated and written upon this subject. The justification for excluding Neanderthal man from our ancestry and putting him into a species distinct from all the living races of men, has now for more than a quarter of a century been admitted by almost everyone competent to express an opinion upon the subject.

Into this stream of settled opinion, placed after so many years of storm, my friend Dr. Ales Hrdlicka of the Smithsonian Institution, has just thrown a pebble of dissent. In the whole range of anthropological controversy no question seemed to have been more conclusively and definitely decided than the status of Neanderthal man. Hence, anthropologists were intrigued to know what new facts or new arguments Dr. Hrdlicka could adduce in justification of his attitude. He was delivering a lecture in London, to commemorate Huxley, who in 1864 expressed the opinion—

> "that the Neanderthal skull exhibits the lowest type of human cranium at present known, so far as it presents certain pithecoid characters in a more exaggerated form than any other; but that, inasmuch as a complete series of graduations can be found among recent human skulls, between it and the best developed forms, there is no ground for separating its possessor specifically, much less generically from *Homo sapiens*." (*Natural History Review*, page 443).

DR. HRDLICKA'S claim was no doubt an act of pious respect to the brilliant biologist in whose honor the lecture was given. But I doubt whether Huxley would have maintained this opinion if he had lived long enough to learn all the new facts that have come to light since the time when he last referred to Neanderthal man. For they have completely transformed the question at issue.



Courtesy *Natural History*, after Boule

THE HEEL, FOR EXAMPLE, VARIES WIDELY

Left: *Heel of chimpanzee;* Center: *heel of Neanderthal man of La Ferrassie:* Right: *Heel of modern man. The axes of the heels lie at widely different angles and the structure is not the same*

At the time when Dr. Hrdlicka arrived in London to deliver his Huxley lecture, two events happened that had a very immediate bearing upon the controversy he was re-opening. At the Royal Anthropological Institute a week before his lecture, Miss Dorothy Garrod gave full account of her discovery (in 1926) of the fossilized remains of a child of Neanderthal type.

From Hrdlicka, Smithsonian Report, 1913

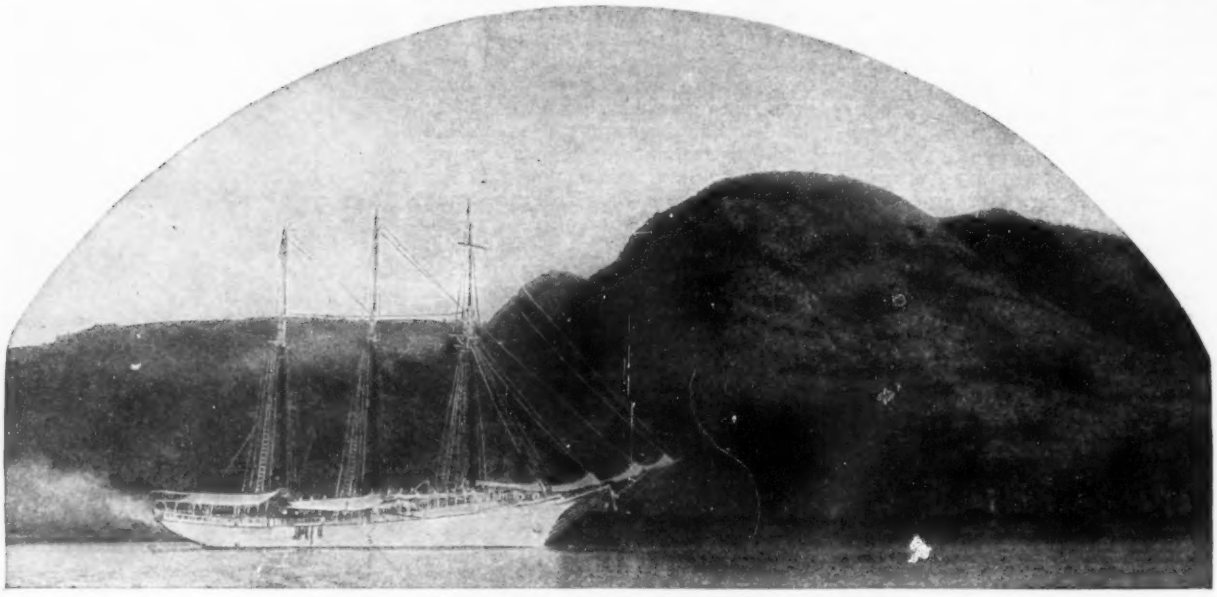
THE GIBRALTAR SKULL

The first Neanderthaloid discovery (1848). Its significance was missed at that early date

Immediately after Dr. Hrdlicka's lecture Dr. G. M. Morant published a detailed statistical examination of the measurements of all the known skulls of Neanderthal type, in which he called attention to the remarkable uniformity of the series, the range of variation being very markedly less than that of modern man, thus effectively disposing of one of Dr. Hrdlicka's chief arguments. He showed that there is a very distinct gap between the relative measurements of the various diameters of the skull when the group of Neanderthal men was compared with the types that occur in modern man, and this hiatus he regarded as sufficiently great to establish a difference in species.

WHILE we all recognize that it is the business of scientists constantly to examine the evidence upon which their theories are based, and if in the light of new information they are found to be inadequate or not to conform to the known facts, to discard them ruthlessly, at the same time it is equally important that theories which provide an adequate explanation should not be abandoned until the new evidence appears, or the new arguments conform to these requirements and really discredit the theory.

My feeling is that the considerations submitted by Dr. Hrdlicka do not establish a case for reconsidering the generally admitted theory, and that none of the points raised by him in any way weaken the force of the overwhelming mass of evidence which compels us to regard Neanderthal man as a species, not only entirely different from every variety of living man, but as conforming to a type that is so highly specialized that it could not possibly have been ancestral to *Homo sapiens*.



THE YACHT "FISHERMAN" IN NEW ZEALAND WATERS

In this yacht, Mr. Grey, the author of the accompanying article, and his party visit remote corners of the world, exploring the depths of the oceans with rod and line. Scorning the use of "mass production" methods of fishing, their search for unusual fish results in great sport

Big Game Fishing in New Zealand Seas*

The Sportsman and the Scientist Work Hand in Hand to Provide Specimens for Museums

By ZANE GREY
Patron of the American Museum of Natural History

MY first fishing trip to New Zealand (1926) was in the nature of a pioneer expedition. The game was new there, and methods and tackle crude in the extreme. We anticipated criticism and opposition, and we certainly got it in plenty. The English anglers were slow even to consider American tackle and methods, let alone to adopt them.

The results of this trip, however, justified our venture and rewarded us beyond measure, and we had the satisfaction of winning a number of New Zealand anglers to our methods. We secured five world records, two of which were phenomenal. Here follows a partial summary of our catch; and the large number we think is justified owing to the desire of the New Zealand Government that we catch and identify and photograph fish, to attract the attention of the scientific and angling world to these new waters.

Captain Mitchell took two black marlin (*Makaira marlina*) of 685 and 976 pounds (the latter the world's record); 21 striped marlin (*Marlina mitsukurii*) ranging from 192 to 350 pounds and averaging 259½ pounds; 3 yellowtail (*Seriola dorsalis*) of 70, 75, and 80 pounds, averaging 75 pounds; and 6 *mako* (*Isurus* sp.) varying from 180 pounds (two specimens) to 299 and averaging 236 pounds.

I TOOK, among other fishes, one broadbill swordfish of 400 pounds—the first *Xiphias gladius* ever caught with rod and reel in New Zealand waters; one black marlin of 704 pounds; 41 striped marlin, ranging from 168 (the only specimen below 200 pounds in weight) to 450 pounds (the world's record) and averaging 268½ pounds; 17 *mako* ranging from 56 pounds (the next smallest being 115) to 300 and averaging 190 pounds. Among others of my catches was a yellowtail of 111 pounds—another world's record.

This extraordinary fishing (surely never surpassed in the angling history of the world) explains why we (Captain Mitchell, my brother R. C. Grey, my son Romer, and I) were all so desirous of making a second trip in 1927. We did make this trip, as the following account tells in part, but owing to 42 days of storm we did not equal our first experience.

The strangest and biggest fish we captured on our second expedition to New Zealand waters was a thresher shark (*Alopias vulpes*) of 640 pounds, incidentally the largest ever taken on rod and reel. But I cannot claim the record because, although I got the strike and hooked the fish, I mistook it for a common shark and handed the rod over to my son Romer.

We were fishing off Stevenson's Island, outside of Whangaroa, where some miles off there is a submerged reef of large area. In 1926 Captain Mitchell and I fished this location and also the Cavalli Islands, where I was the first to land a swordfish. Both places have since become popular with anglers. These are indeed magnificent fishing waters. During the summer great schools of *kahawai* and *crevallé* feed there on the surface at certain hours of the day. While feeding, one of these schools will make a rushing noise like the tumbling of a brook over

*Published by permission of Mr. Grey and *Natural History*.

stones. At such time swordfish, *mako* and other sharks abound.

The thresher shark is one of the rare fish of the seas. At Catalina I have had several follow a trolled bait. They stuck their long tails out of the water and struck at the bait with them. Of all strange weapons that have evolved upon fishes of the seas, I think the tail of the thresher is the strangest. If his body is nine feet long, his tail will be ten. When swimming, he can look backward and upward at the tip of this tail and strike very accurately with it, since his eyes are situated almost on the top of his head. He makes one think of a prehistoric monster that has survived to the present.

THREE threshers have been caught at Catalina in twelve years—all small ones, around 300 pounds each. Each one was hooked through the tail. They had snagged themselves on the hook while striking at the bait. In New Zealand threshers are caught pretty often, and run fairly big. Often they leap like greyhounds of the sea, a most unusual and wonderful spectacle. And they are hard-fighting fish.

This 640-pound one that I ran on to in New Zealand, fooled me in the strike. He had not shown on the surface and his bite was nothing much to speak of. But he felt heavy and slow, like a *reremai*—a ground or sand shark—so I gave the rod to my boy with the remark: "Here, Romer, see how quickly you can lick this fish."

Now Romer is a husky lad and has had some luck with big fish. As all boys do, he brags a little. Sometimes seeing me or Captain Mitchell or R. C.* in difficulties with a big fish he is prone to remark: "Say, it takes you a long time on that fish. Pull his head off. I could!"

*My brother R. C. Grey.

A "MAKO" SHARK

The author, standing beside a 278-pound mako shark which was caught and landed with the rod and line which he holds. Fish of this kind put up a terrific battle

However, Romer met retribution in this thresher. For the first hour he could do nothing with the fish. Meanwhile R. C. came up and made remarks. "Why don't you pull him up? You're weak in the back, boy. We can't hang around all afternoon."

Then Captain Mitchell ran up in his boat: "Hey, Romer, what're you on? We're mighty curious to see if you can lick him." And I said: "Son, for a boy who's a sprinter and who aims for football, you are sure slow as an angler."

Altogether—for the boatmen and his pal, Johnny Shields, got after him too—we made him see red. It really was a mean trick. But Romer himself sometimes plays mean tricks. However, he worked on that fish as he had never worked before on anything—and he has fought some pretty good battles.

At the end of two hours he had the thresher stopped, and in another hour and a half he had him whipped. Really he gave a magnificent exhibition. He blistered his hands, lamed his back, and ruined my rod, but he whipped the thresher.

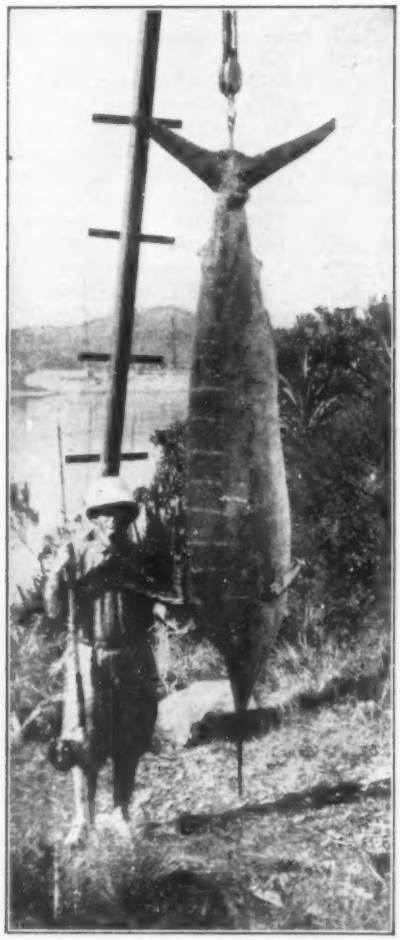
WHEN the great fish came up so we could see him, I certainly sustained a shock—and I have seen a great many remarkable sea-creatures come up out of the deeps. He was a huge, grotesque, frightful, and terrible fish to gaze upon. All my fishing years I had longed to catch a great thresher. Here I had struck one—a record—and had turned the rod over to my son! The joke was on me.

The thresher must be classed as a game fish. He fights deep most of the time and is exceedingly stubborn. Comparing him with the *mako*, he is pound for pound a harder fish to whip.

The *mako*, however, is the aristocrat of all sharks. It is really unfitting to call him a shark at all. I seldom use the word with regard to him. And after he attains some weight—say over 400 pounds—he is indeed a magnificent sporting fish. His leaps are prodigious, inconceivably high above the water. The ease and grace of this leap is indescribable. It must be seen. He

A THRESHER SHARK ON THE BEACH

This shark, classed by the author as a game fish, has the peculiar feature of an unusually long tail. If the shark's body is nine feet long, the tail will be ten feet long. It was one of these sharks that Mr. Grey's son battled for six and a half hours, and conquered



R. C. GREY AND SWORDFISH

The author's brother poses with a 386-pound striped marlin swordfish. This fish comes next in size to the author's record catch of a 450 pounder, landed in 1926

comes out slick, glides up, turns a somersault, and goes down heard first, like a diving gull, almost without a splash. Then instantly he is out again. Seldom does a *mako* leap once only. I have had one go up six times—a most thrilling sight. His third leap is always the highest.

The *mako* seems to be known only in New Zealand and Japanese waters. He attains huge size, up to 2000 pounds. Captain Mitchell hooked one in 1926 that leaped twice—the first time scaring us nearly to death, and the second giving us time to judge his weight fairly at around 1200 pounds. Needless to state here, that *mako* is still roaming the sea. Some day, though, we will catch one that large or even larger.

We caught two black marlin in New Zealand waters in 1927, both small fish—340 and 380 pounds. Quite a comedown from our 1926 fish of 704 and 976 pounds. However, the capture of any black marlin is an event to be proud of, and 1927 was a bad season because of rough waters. Captain Mitchell's fish, the larger of the two, leaped out of the water as the captain was winding in the bait, and nearly landed in the boat. The fish was after that bait and he got it. Then he gave a grand exhibition of fighting on the surface. My black marlin, 340 pounds, charged my "teasers" and bait, and certainly committed suicide.

It is my opinion that fishes of this species do not like rough water, as the striped marlin do. During three months, I had hold of only one, beside that which I caught. I saw this fish heaving up behind my bait and he sure was big. He took it and I struck at him, but—alas!

We saw a very large black marlin, surely a 1000-pounder, riding the swells. It was in shore near the entrance to the Bay of Islands, on the way to my yacht at the close of day when we had no good bait. I put on the only one there was—a *kahawai* stiff as a poker.

AUTHOR AND SON

The 640-pound thresher shark is shown. Note the extreme length of its strong tail

We followed this marlin—all three boats—and the closer we got to him as he rolled up in the swells the louder we yelled. If I had known then that we were going to see swordfish in the South Seas twice as big as this one, I might have saved my breath. But there are lots of things we do not know until they happen. Anyway when I got my bait in front of this marlin and he sheered off after it, I nearly had a fit. He refused to take it. We followed, and made careful approach to drag the bait again before him. He came to it and swam clear round it. We were sure he would bite. He did not. Then I did have a fit.

My brother, R. C., struck a striped marlin off the Cavallis which gave perhaps the greatest surface exhibition I ever saw. This fish was one of the long slim ones, as marlins go, but he was so swift in his leaps that we could not train the cameras on him, and so strong that R. C. could just barely stay with him by running the launch full speed.

IT was bright sunlight, with just a ripple on the dark blue sea. The marlin blazed in the air, green on the back, striped across his silver-white sides. He cracked the water like pistol shots; he made every kind of a splash, from a thin cutting of spray to a great, angry boiling maelstrom. The beauty and wonder of such spectacular acrobatics must be seen to be believed and appreciated. Especially must the magnificent fury or fright of this tiger-species be seen. It cannot be adequately described. This marlin weighed 386 pounds, and comes next to my record (450) of 1926.

CAPTAIN L. D. MITCHELL

He is shown here with a 976-pound black marlin swordfish. This is the largest one caught during the 1926 season, and exceeds any caught on the last expedition

Giving Scales a Variety of Jobs

Balance Scales Now Used for Many Purposes Besides Simple Weighing

IN written history, the first reference to weighing is given in the narrative of Abraham's dealing with the sons of Heth. He paid them 400 shekels for a burial place, weighing out the money with a balance. This ancient medium of exchange was not a coin in the sense we know it, but was the amount of silver equal to the shekel weight—about one ounce avoirdupois.

In Act 51 of King Henry III, dated 1266, is written: . . . an English penny called a sterling, round, and without any clipping, shall weigh 32 wheat grains in the midst of the ear."

Thus this method of counting monetary value by weight survived the vicissitudes of many years despite the introduction of the coinage system. Today, scales are being used to count, not monetary value, but the number of small parts, such as screws or bolts, in a mass; the number of yards in a bolt of cloth; or the number of gallons of liquid in a container.

Knowing the exact weight of one unit of the mass or volume to be counted or measured, it is an easy matter to weigh the whole on an accurate scale and, by simple division, find the quantity of the mass in whatever units may be desired.

Suppose, for example, a steel hammer, a yard of woolen cloth, and a pint of liquid each weighs one pound. We weigh some of each and find that each totals 20 pounds. We know then that we have 20 hammers, 20 yards of cloth, and 20 pints of the liquid.

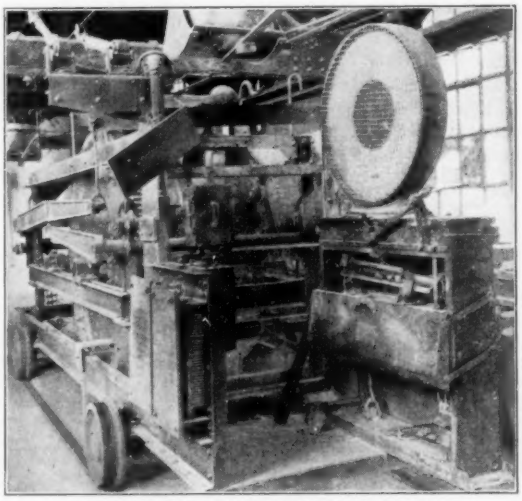
TO obviate more laborious methods, this principle is being used in industry to count bolts, nuts, machine parts, and many other products, to measure spring tension, horsepower, liquid volume, and for sorting, checking, and testing in a great variety of ways. The automatic scale, employing no springs but depending on balance rather than distortion, is commonly used today to hold down a great number and variety of odd jobs.

COUNTING A SHOVELFUL

Weights in the pan on tare beam lever, indicate, by ratio, the number of hinges weighed

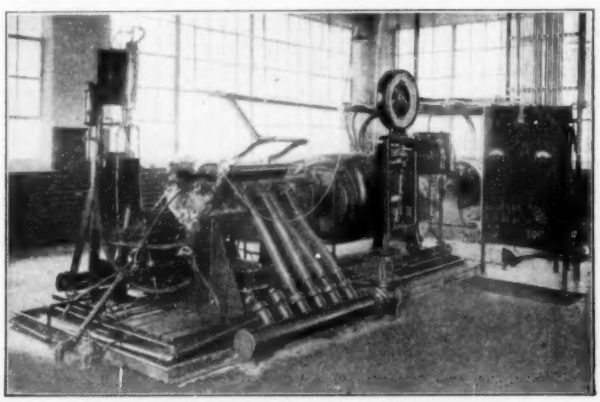
SORTING EQUAL-WEIGHT SETS

Connecting rods are here weighed and placed in sets to minimize grinding work



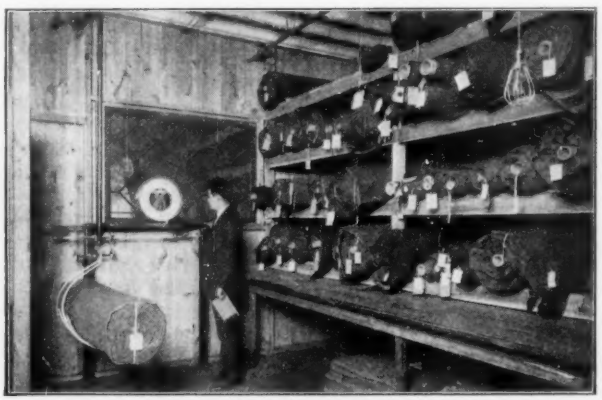
BATCH WEIGHING IN GLASS PLANT

This hopper scale passes under hoppers; material is drawn from each; weighed; mixed; and then emptied



SCALE FOR "WEIGHING" HORSEPOWER

Used with Sprague dynamometer, this scale may be designed to show torque in pounds, or horsepower directly, of an airplane motor



YARDAGE SCALE FOR HEAVY FABRICS

A perpetual, accurate inventory of valuable upholstery fabrics may be maintained with this scale which shows number of yards in the roll

What Becomes of the Starlight?

If Space Is Infinite and Finally Empty, the Energy Radiated From the Stars Must Go On Forever; But if Space is "Curved"—What Then?

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

THE engineer is always keenly alert to secure the highest possible efficiency in his machinery. Whether he seeks to transform electric energy into light in a lamp, or power in a motor, or mechanical into electrical energy in a dynamo, or to turn heat into mechanical energy in a steam or in an internal combustion engine, he desires always to reduce the wastage incidental to the transformation.

In some cases such as the electric motor these losses are small, but in heat engines of whatever sort they are inevitably large. From the very nature of things as expressed in the famous "Second Law" of thermodynamics, it follows that when we take heat into our engine from a source of high temperature we can turn only a part of it into mechanical work and must dump the rest, still in the form of heat, into some region of lower temperature—for example, into the water which cools the condensers of a power plant. The energy comes to us at first in the form of rapid chaotic motions of the molecules. We can turn part of it back into orderly motion of our machinery, but not all—the rest still remains attached to molecular motion and must remain thus as long as we have no way of stopping this motion entirely; that is, working with the cold side of an engine at the unattainable absolute zero.

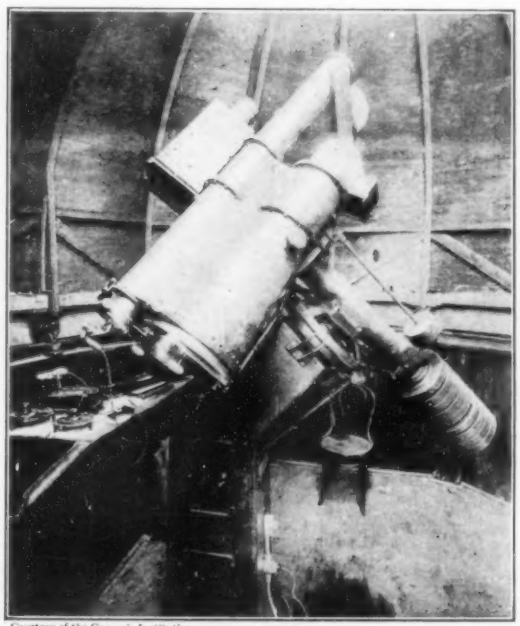
YET even our power engines have an efficiency of 10 percent. How is it with those vaster engines which nature shows us in action—the stars?

The stars may be regarded as heat engines in the physicist's sense of the word—on an enormous scale. They are drawing upon internal energy of some sort, transforming it into heat and radiating it away into space. What becomes of the heat? Is any of it "used" and if so, what fraction?

If we are to count as energy "used," only that fraction which falls on other known bodies, the efficiency of a star—and in particular of the Sun—is almost incredibly small. Of the whole flux of radiation from the Sun only one part in 230 millions is caught by all the planets together. The rest goes out into interstellar space. The fraction intercepted by the other stars must be excessively minute. Far more is taken up by the dark nebulae—on account of their enormous size—than by all other known bodies together. But even these cover but a moderate part of the heavens, and most of the radiation passes out beyond them into the unknown.

Moreover, the radiation which is intercepted, for example, by the planets, is not permanently trapped. A very small part of it may be stored by chemical change like that which had gone to make the earth's coal beds, but almost the whole goes to heat the body on which it falls and to raise it to such a temperature that it radiates heat away on its own account as fast as it receives it; and again the flying energy, after a transitory delay, is

"On the old road from star to star
A wanderer and a vagabond."



Courtesy of the Carnegie Institution

THE FAMOUS BRUCE TELESCOPE

Camera with which the photographs for the remarkable new Barnard, Milky Way photographic atlas were made. The main lens is ten-inch doublet

We can be quite sure that not one part in 10,000 millions of the Sun's heat is permanently stored as energy in any known body. If to make such a transfer of energy from place to place were the Sun's business, we would conclude that its efficiency was less than 0.0000000001. But we have no valid reason for making this assumption. Whether we can say anything at all about the efficiency of the stars depends upon what we may conclude about the fate of the radiation which escapes far into the depths of space millions of light years from its source. No certain answer to the question can be given in the present state of human knowledge, but several possible answers present themselves for our consideration.

FIRST, it may be that space is infinite and—outside the region occupied by the Milky Way, the star clusters and the nebulae—practically free from obstructing matter of any sort. In this case the escaping radiation will simply go on forever, speeding out ever more widely and growing correspondingly feebler. If, as most astrophysicists now believe, the radiation of the stars is maintained by a gradual transformation of their substance (mass) into energy (heat), after the manner imagined by Einstein, it might be conceived that all matter might aggregate into stars and that, in the course of sufficient time the stars would wear themselves away and disappear. The energy derived from the transformation of their substance would leave the once star-sown portion of space and become lost in its infinite depths, and the material universe would have vanished into the void.

There is nothing known to science which is hostile to this prophesy—except that the concentration of all matter to form stars appears improbable. The prospect which it unveils is, however, esthetically disagreeable to most people—just why, the writer has never been fully able to understand. But, fortunately, other forecasts are possible.

It may be, for example, that space is not infinite but returns upon itself in some fashion. If we come down to the simple case of space of two dimensions—a surface devoid of thickness—we can see at once how this can happen; as in the obvious case of a sphere, and in many other ways represented by other less regular closed surfaces. We cannot make any picture in our minds of how space with its three dimensions may be similarly re-entrant; but the mathematician will tell us that this is because our imagination is unequal to the task of getting outside the space in which we live and move, and viewing it as a whole as we view the surface of a ball. By his more powerful tools of analysis he can show that the idea of space returning into itself is logically consistent, with nothing at all absurd about it.

WE cannot, indeed, determine whether the actual space in which the stars are situated is "flat" (that is, infinite) or "curved" (that is, re-entrant). All that we can say is that if it is "curved" the portion which extends out to the remotest visible nebulae must be but a very small fraction of its whole extent, so that its "curvature" would no more need to be considered than the curvature in the ordinary sense of the earth's surface (which we call sea level) needs to be considered in crossing a Hudson River ferry.

If space is "curved" the escaping radiation must alternately return and sweep about it forever from one part to another. We can be sure that it does not return upon its path so precisely as to be focused, so to speak, once more upon the point of its origin, for in that case we should see light shining from places where stars once were and are no longer (since all the stars are moving). But if the return is not so precisely upon the same track it is quite possible that we should simply have scattered radiation flying about in all directions through space.

Such diffuse radiation would probably be very feeble. Jeans—basing his calculations upon best available data—finds that if all the matter contained within the region of the spiral nebulae were converted into radiation, and this radiation condemned to wander endlessly about this same region, the average intensity of the radiation would be about that of ordinary moonlight. That is, about 500 times as great as the light of the stars on a clear moonless night.

We see, then, that if space were everywhere filled with stars and nebulae as densely as it is in the region that we can observe, and if all these except the solar system were turned into radiation, we would have a far brighter sky than we now see. But if the whole extent of space were a few hundred times greater than that of the nebulae-filled portion of it, the whole material universe might disappear and leave no trace except a feeble diffused illumination like our present starlight.

BUT is this the end? May not the process of conversion of matter into energy be reversible so that the diffuse energy of radiation ultimately becomes reconcentrated into atoms, starting a new cycle of change; and so on forever?

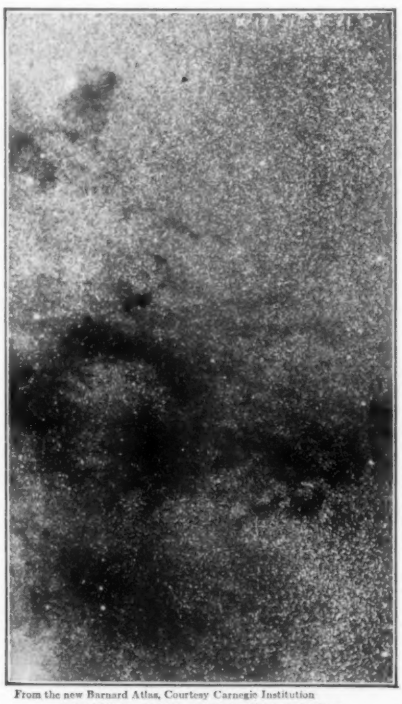
No one can answer this question. We know of no process by which this change might be effected; and when it comes to details it is very hard even to imagine any. In the diffused state of radiation contemplated by Dr. Jeans, the amount of energy which is required to make a single hydrogen atom would be spread through some 400 cubic feet of volume. How all this could be concentrated into the minute region which the newly formed atom would occupy, is beyond our imagination to conceive.

The riddle becomes still more difficult when it is realized that the radiant energy is not stationary, but is flying about in all directions with the velocity of light. Moreover, unless the radiation were of even shorter wavelength than the most penetrating of the cosmic rays which Dr. Millikan has so brilliantly investigated, a single quantum or natural unit of energy of this radiation, if turned back into matter, would not make nearly enough to form an atom. We would then have to suppose that dozens or hundreds of quanta of radiation coming from different origins, in some way were simultaneously combined to form our new-born atom. To picture such an event certainly staggers the imagination. Dr. Millikan's bold suggestion that the production of the cosmic rays results in some cases from the union of 28 hydrogen atoms to form a silicon atom is comparatively tame, although it is not easy to see how the 28 electrons and 28 protons can all get to the same place at the same time or nearly enough so to form a heavy atom.

BUT it would not be justifiable to say that because we cannot imagine how a thing could happen, it is impossible. It may be that atoms are reformed from radiation somewhere in space, but we have not the least evidence they *can* be so formed—much less that they *are*.

Our speculative thought has wandered far beyond the bounds of experience and the knowledge based on it, and the only sound intellectual position on this question is agnostic. We simply do not know.

¶ *Once more the famous non-magnetic ship* Carnegie *is sailing the seven seas in search of fact. What fact—merely the state of the earth's magnetism? Far from it. The many things the scientific staff is doing on the long voyage will be explained authentically in a future article.*



From the new Barnard Atlas, Courtesy Carnegie Institution

STARS AND COSMIC DUST

These lie within our own universe, yet there are a billion of them within photographic range. We know of some hundreds of thousands of other universes, many of them doubtless as large or larger than our own universe

Courtesy of Mt. Wilson Observatory

ANOTHER UNIVERSE

Beyond the spiral nebulae (other universes) what? Emptiness; or is spaced "curved" and finite? Here is a case where our common sense tells us one thing and our reasoning suggests the opposite. Time may tell

Farming *Under* Paper

Crops Will Be Bigger, Earlier, More Numerous and Produced With Less Labor When We Grow Them By the Method Now Used With Tremendous Success to Raise Pineapples In Hawaii

By MILTON WRIGHT

THE pineapple growers of Hawaii last year paid 500,000 dollars for paper under which to grow pineapples. You can buy a lot of paper for a half million dollars, but then a lot of pineapples are grown in Hawaii and 90 percent of the crop is grown under the paper. Of course, the growers get back the money they spend for paper—they raise 30 percent more pineapples than they otherwise would—and there is a tremendous saving in labor.

THE ORIGINAL PAPER FARMER

What helps sugar cane in Hawaii should help other crops elsewhere, he reasoned

BUT the Hawaiian pineapple crop is only the beginning. Without any great stretch of the imagination we can see the day—not so very far off—when nearly all our plants—potatoes, corn, tomatoes, spinach, cotton and what not will be grown under paper.

For four years the Department of Agriculture has been carrying on a number of experiments with it and their comparative tests have demonstrated beyond dispute the value of paper to stimulate plant growth. With every crop save one—peanuts—the experiments were an unqualified success.

To understand the use of paper in agriculture, suppose we go back to its origin. On a sugar plantation near Honolulu, before the World War, Charles F. Eckart found it a stupendous task to keep down the weeds which sapped the life of his crop. Year after year he had been heaping crop refuse between the rows—mulching is the term farmers use—for the double purpose of blanketing the weeds and retarding the evaporation of moisture. There was an objection to this, however. The mulch would decompose after a short time and, becoming a part of the soil, would actually encourage the growth of weeds.

If only Eckart could find a mulch that would control the weeds permanently, he would be making a tremendous stride forward. At last he hit upon a tough kind of paper. He impregnated it with asphalt and laid it on the ground over the fresh cut stalks and seed cane. To hold the paper down he turned the soil over the edges. The sharp shoots of the young plants easily stabbed their way through the mulch of paper, but the weeds were effectively smothered.

The idea grew. That a paper mulch meant farming without weeds was readily understood, but other advantages began to be realized. It meant bigger and earlier crops with less labor. The use of black paper, it was found, raised the temperature of the soil, for the black surface of the paper absorbed the rays from the sun. Also the soil did not cool so quickly. The activity of bacteria was increased with the rise in the temperature of the covered soil.

Furthermore, the moisture remained in the ground until it was absorbed by the plant roots instead of being wasted quickly by evaporation. Then, too, the paper preserved the original cultivation of the soil throughout the growing period. You tilled the earth once at the beginning of the season and no more, save for turning the earth over from time to time in the rows by machine.

THERE were many reasons why plants should benefit greatly from the heightened temperature of the soil. Bacteria break down organic compounds and convert them into nitrates and other soluble forms to nourish the plants. These micro-organisms are extremely sensitive to temperature conditions. When the temperature drops below 41 degrees, Fahrenheit, they cease to develop nitric acid. At 98 degrees they are at the height of their vigor. At 113 degrees their activity drops back again to what it was at 59 degrees. It is important, therefore, that the soil temperature be right, and any means which keeps the soil temperature at a proper level is worth while.

Another factor in plant growth stimulated by soil temperature is osmotic pressure. Osmosis is that process by which the moisture is carried from the soil into the roots and through the stems and leaves; upon it all plant development depends. The

A DIVERSIFIED CROP TEST

Before the tiny shoots of plants, grown by the age-old method, have done much more than peep above the surface, the mulch-paper protected plants are well on their way toward maturity

degree of osmotic pressure and the rate of its action depends upon the temperature—the higher the temperature the greater the osmotic pressure. Tobacco plants and pumpkins have been known to wilt at night, even when there was abundant moisture in the soil, as soon as the soil temperature fell much below 55 degrees.

Some soils, of course, absorb much more heat than others, the temperature being largely dependent upon the color. Dark earth absorbs more heat than light-colored earth, and soils of any color at night or in cloudy weather have a tendency to cool off until they reach the temperature of the surrounding air. Usually dark soils remain slightly warmer than light soils at night, but this difference is much more pronounced between soils which are covered with mulch paper and those which are not.

THESE CUCUMBERS ARE FOUR WEEKS OLD

The plants at the left were grown under mulch paper. Their growth is not only great but uniform. The plants at the right were given the usual care accorded to cultivated vines. Note the difference

WHERE you have the same moisture content in a light colored soil and a dark one, the dark colored soil shows the greatest gain when you use dark colored mulch paper. Black soil absorbs the most heat, brown next, red next, yellow next, and gray the least. When mulch paper is used, the heat-absorbing capacity of all the various colored soils tends to be equalized. The soil which ordinarily is a good heat absorber becomes a better heat retainer, and the soil which has the least heat retaining capacity is raised to the capacity of the greatest.

With one unused to the use of mulch paper, the thought is likely to occur that rains would be prevented from reaching the soil under the paper. The fact of the matter is that the water reaches the soil through the openings where the plantings are made or between the edges of the paper and seeping downwards or sideways, due to gravity and capillary action, is stored up under the blanketing effect of mulch paper.

With the theory of mulch paper being so sound and full of promise, to say nothing of the remarkable results achieved in the Hawaiian Islands, the Department of Agriculture and others began experiments in this country in a variety of climates and soils and with a variety of crops. Side by side plantings were made, one set under mulch paper and one set uncovered. With sweet corn, beets, sweet potatoes, white potatoes, turnips, tomatoes, spinach, cotton—with every crop which was tried, save one, the results were phenomenal. Here where the paper was used in the middle of the growing season you would find nothing but splendid, luxuriant growths. There, where there was no paper, you would see the weaker brothers and sisters of those same plants, their growth lagging far behind.

THEY OVERCOME PERSPECTIVE

The plants in the background actually loom up larger than the unpapered crops

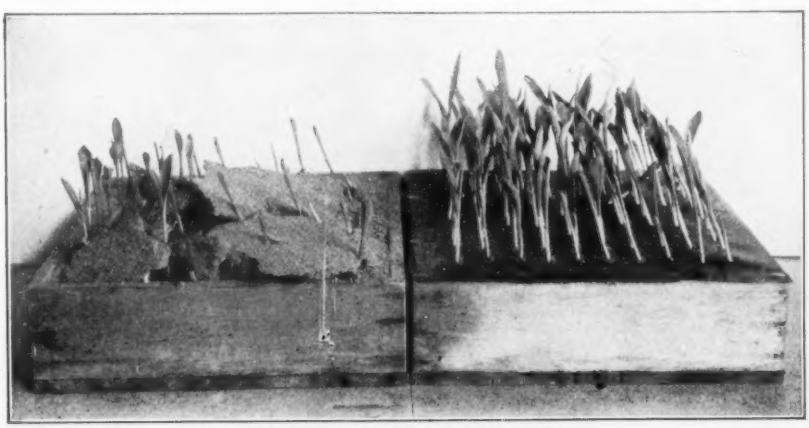
THE single exception was peanuts. Instead of increasing the yield, mulch paper actually decreased it by 46 percent. The explanation lay in the fact that the mulch paper prevented the natural pegging of the plants.

Here are the results from trials with and without mulch paper at the government's experimental farms at Arlington, Virginia. The percentages show the increased yield of the mulched areas.

White potatoes	73 percent
Cotton	91 percent
Sweet potatoes	122 percent
Celery	123 percent
Peppers	146 percent
Eggplant	150 percent
Green beans	153 percent
Beets	409 percent
Carrots	507 percent
Cucumbers	512 percent
Sweet corn	691 percent

One thing made clear by the experiments is that not only are crops more abundant, but they are earlier. In many cases this affords the possibility of an additional planting before the growing season is ended.

Applying mulch paper to a crop area is simplicity itself. The paper comes in rolls—150 or 300 yards long and in widths of 18 and 36 inches. The farmer lays the roll down across one end of a



RESULTS IN THE LABORATORY

The soil on the unmulched onion sets at the left formed a hard cake through which the shoots had to force their way. Under the paper the soil remains soft and retains a lot of moisture

WHERE MULCH PAPER MAKES ITS MARK

Observe what looks like parallel lines running across this field of pineapples. Each line is a row of plants not protected by special mulch paper. They did not grow as high as the others

row of cultivated soil and unrolls it to the other end over or between the beds. The paper is thus in direct surface contact with the beds. Where drill crops are to be planted a strip of two inches or less is left between successive strips. The paper is anchored to the ground with stones laid on, with staples driven through, or simply with dirt turned over the edges. In broad fields, where the strips are some distance apart and the wind has a chance to lift the edges, it generally is best to turn the edges of the paper down into shallow trenches and cover the margin with soil.

AN easy way to lay the paper in general field work is to fit an adjustable handle into the ends of the roll. One man takes the handle and walks away from the paper, rolling it out, while another man on each side turns enough dirt over the edges with a small hoe to hold it down from the wind until small plows can throw soil over the edges to hold the paper in place permanently. In Hawaii, where thousands of miles of paper are laid each year, specially designed paper-lying machines are drawn by mules or tractors. With a single operation such a machine prepares the bed, lays the paper and covers the edges.

Planting is done by either of two methods—through the paper or between strips of paper. Where you have such crops as tomatoes, eggplant, peppers, pineapples or field corn which require rather wide intervals, the best way is to plant in regularly spaced openings made through the paper. The opening may be made in any one of several ways. With pineapples, for example, the usual practice is to stab a hole through the paper and into the soil with a rounded stick or dibble. The pineapple slip is then placed in the plant bed through the opening. Sun-grown Sumatra tobacco also has been grown successfully when the planting has been done by this method, the increase in yield amounting to as much as 71 percent over the old method.

With tomatoes and other less hardy plants, it is advisable that the openings be made sufficiently large for some uncovered soil around the plant's base. Usually a hole about four or five inches

TOMATOES FIVE WEEKS OLD

Such plants not only grow faster but show a 44 percent increase in yield

in diameter is sufficient. With a smaller opening the tender plants are likely to suffer while they are getting started.

Sometimes plant openings are made by making criss-cross slits in the mulch paper in such a manner that the edges may be folded back as flaps. It is possible to so adjust these flaps that considerable protection from the wind is given to the young plants. One possible objection to these flaps is that in some places they are likely to offer a barrier to rainfall which otherwise might drain through the openings. Where there is too much rainfall, however, the barrier provided by the flaps may prove to be an advantage.

With carrots, radishes, spinach and other drill crops sown in rows close together, the planting is done between the strips of paper. Each strip acts as a sort of watershed carrying the rainfall direct to the root area. When such a method of using the paper is employed the weed growth is confined to the narrow planting strip, rarely more than two inches wide, and the work of cultivation is reduced to a minimum.

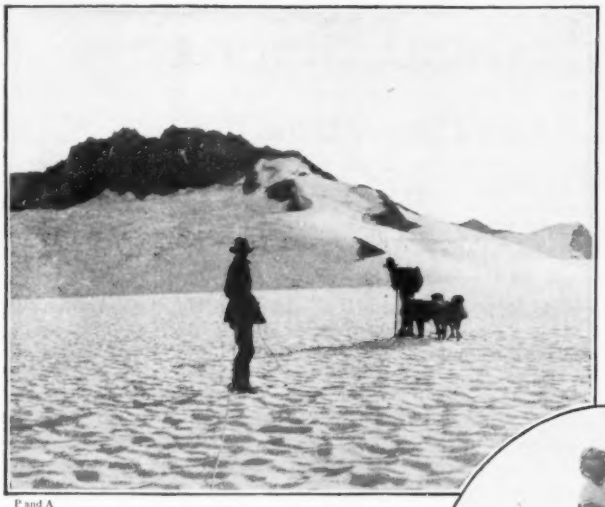
SOME crops, of course, benefit more than others by the use of mulch paper. The heat-loving type of plants, such as pineapples, tomatoes, cucumbers, tobacco, eggplant, peppers and sugar cane, seem to respond best, but many kinds of berries, nursery stock and vegetables, also, probably could use it to great advantage. There is little doubt that as mulch paper becomes more widely known and used that methods of adapting it to crops of all kinds will be developed and its efficiency heightened still more in producing bigger crops, earlier crops, additional crops, and crops cared for with less labor.

Already, as a result of the success in Hawaii, extensive trials are being made with various crops in Africa, Australia, Asia, the West Indies and Europe, as well as in the United States. The reports of all of them strongly suggest that the practice may become a general one, and that it is soundly economic.

Think what it may mean! No more drought-born famines. No more barren acres. No more ceaseless toil from dawn to dusk in the never ending battle to kill cursed weeds, robbing precious plants of their food. Freedom from fear, freedom from drudgery! At last the man with the hoe may throw away the symbol of his serfdom!

YOU MAY PLANT THEM AND FORGET THEM

Plants grown the old-fashioned way must be cultivated constantly to kill the weeds. With the mulch paper the initial cultivation is the only one needed. The tilth may last several crops



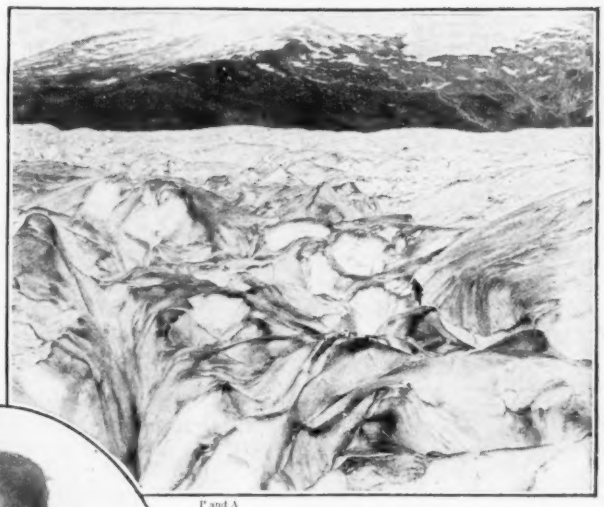
P and A

DANGER LURKS BENEATH ▲

Crossing an area of hardened crust any part of which may conceal a bridged-over crevasse. Picture shows Henry Pigg, a lad of 18, and Jack Kobz, a Swiss, who accompanied Father Hubbard, insert at the right, on his traverse of the 90 mile ice area

MENDENHALL GLACIER ▼

Photograph was taken at the terminal of the glacier and shows a stream flowing from beneath its ice foot



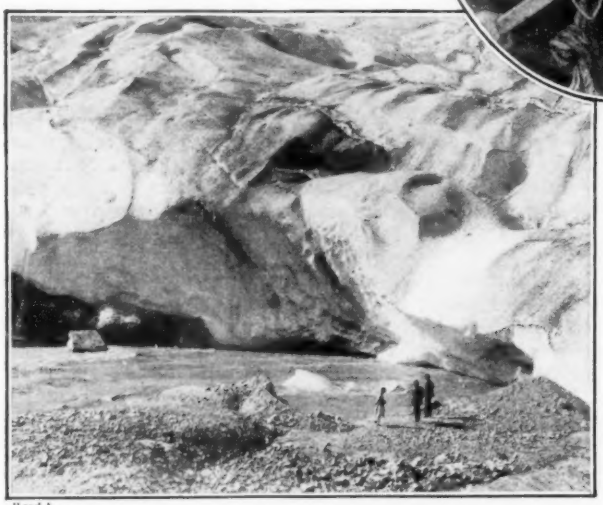
P and A

▲ CROSSING TAKU GLACIER

The surface of a glacier seldom provides smooth sledding. Usually it is a welter of dangerous crevasses into which the unwary traveler may fall to unknown depth, and if not rescued in time will find an icy tomb

▼ WHERE THE TRIP ENDED

From a distance, an expanse of ice of this nature presents a negotiable appearance, but crossing it involves the solution of an intricate puzzle



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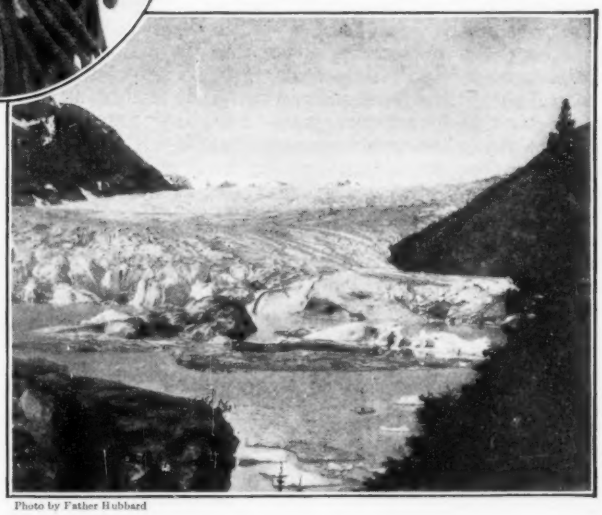


Photo by Father Hubbard

Priest-Professor Conducts Daring Exploration

TO demonstrate his belief in the existence of a huge interior mass of ice several thousand miles in area, in the hitherto unexplored region not far back of Juneau, Alaska, Father B. R. Hubbard, priest and professor of the University of Santa Clara, California, has made a remarkable traverse of a 90 mile stretch of the hardest kind of "going." To quote Father Hubbard:

"I attempted the trip with a young Swiss traveler, Karl Tinglay by name, but his unfortunate fall of over 40 feet into a crevasse landed him in the hospital for the rest of the summer. I could find no one else with the necessary experience for so hazardous a trip until I met Jack Koby, a prospector on the Taku. With his three pack dogs and a student, Henry Pigg, we started off to climb the face of the Mendenhall Glacier. All that day we skirted ice falls, leaped crevasses, each man roped to a dog, slushed through half melted snow until close to midnight. During the three hours of night we huddled together on a moraine rock until daylight permitted us to stretch our frozen limbs. For two more days and nights we wandered through a labyrinth of rocky *nunataks* and *cirques*, climbed ridges and cliffs bordering rivers of ice until after covering over 90 miles with hardly six hours rest all told during the three days going, we arrived all but exhausted at the end of the Taku Glacier. The results were gratifying, confirming as they did the existence of the huge interior body of ice back of Juneau, and contributing much interesting and scientific data on glacial geology."

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Martyrs of Medicine

THE death within one year, in Akkra, in South Africa, of three workers in yellow fever, adds to the long roll of the martyrs of medicine, to the list of physicians and investigators who have died as a result of disease incurred during research for methods to relieve suffering and to prevent death.

Last September, Dr. Adrian Stokes died of yellow fever, at only 40 years of age. He had already contributed greatly to medicine, particularly in the field of bacteriology, and he had shown the possibility of inoculating rhesus monkeys with yellow fever. On May 21, Dr. Hideyo Noguchi, noted Japanese investigator, died of yellow fever in the same place while in the midst of researches attempting to identify the South American form of this disease.

Among the contributions for which Doctor Noguchi was especially noted were pure cultivation of the syphilitic organism; the demonstration of the presence of the syphilitic organism in the brain in general paralysis and in the spinal cord in locomotor ataxia; cultivation of micro-organisms associated with infantile paralysis and rabies; the introduction of the luetin test for syphilis; the introduction of a method for obtaining a bacteria-free vaccine for smallpox; the isolation and cultivation of the micro-organism *Leptospira icteroides* associated with yellow fever, and simultaneously the development of a preventive vaccine and serum for use in treatment. His most recent publication dealt with an organism associated with trachoma in American Indians. For his work he had been honored by practically every important government in the world.

On May 30, Dr. William Alexander Young, third member of the investigating party, also succumbed to yellow fever.

The roll of medical martyrs, beginning with Servetus and Semmelweis, who died for their opinions, includes, as listed by Garrison in the forthcoming edition of his notable "History of Medicine:"

Daniel A. Carrion (verrugas), Jesse W. Lazear (yellow fever), Alexander Yersin and Hermann Franz Müller (bubonic plague), Tito Carbone (Malta fever), Allen MacFadyen (typhoid and Malta fever), J. Everett Dutton (African relapsing fever), Howard Taylor Ricketts (typhus), Bacot (typhus fever), Thomas B. McClintick (Rocky Mountain fever), William Ironside Bruce (aplastic anemia), Pirrie (kala azar) and Gaspar Vianna of Brazil (postmortem sepsis).

All of these men lost their lives in investigating the diseases with which their names are associated. Almost coincidently with Röentgen's announcement of the X ray, Albers-Schönberg, in Germany, began his series of experiments. Schönberg died of cancer after suffering repeated mutilations due to the effects of the X ray.

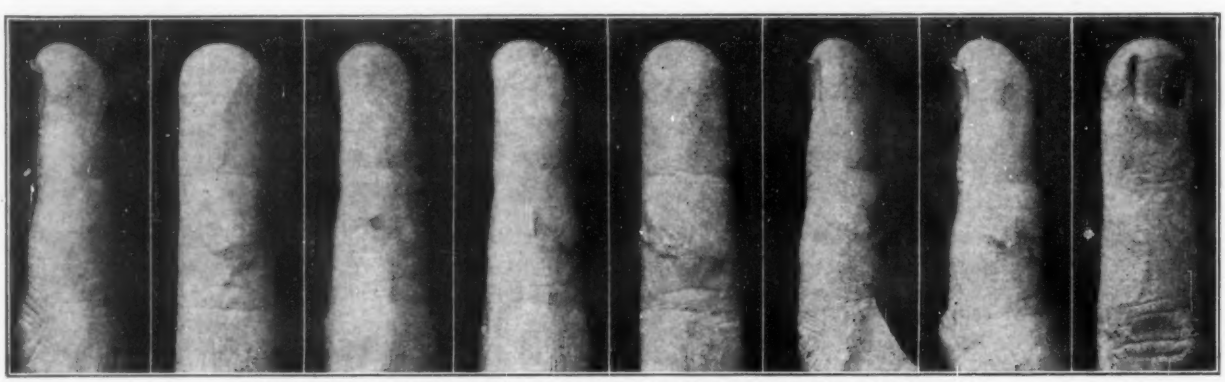
Among others who had anywhere from five to 30 operations as a result of similar investigations and who died eventually of X-ray cancer were Drs. Bergonie, Spence, Blackall, Hall-Edwards and Menard. Associated with these men were many technicians whose lives also were sacrificed to their studies. In this country, numerous physicians who devoted themselves to röentgenology before all of the associated dangers were known, have died and continue to die from X-ray cancer.

To this list of physicians must be added also the names of many men who have submitted themselves to inoculation in association with the study of dengue fever, of influenza, of measles and of scarlet fever in order that more might be known concerning these conditions. The names of such famous investigators as John Hunter, Hammond, Carroll, Halstead and Henry Head are included in the list of those who have run definite risks by experimenting on themselves but who recovered from the experimentation.

Creeping Eruption

DURING the rainy portion of the summer in the south Atlantic and Gulf sections of the United States, many people suffer with disturbances of the skin which take a peculiar form. The disease was first described in England in 1875 by R. J. Lee, who noticed the advancing area of inflammation under the skin which he called, therefore, "creeping eruption." Since that time several other physicians have noticed that in certain cases of diseases of the skin a living organism under the tissue burrows through and sets up inflammation.

In 1924, in a clinic held in Jacksonville, Florida, Dr. J. L. Kirby-Smith found 179 such cases among the people who were examined. He made careful microscopical studies of the organisms, picture of which is shown herewith. In



AN EXAMPLE OF THE SKIN TROUBLE KNOWN AS CREEPING ERUPTION

This series of photographs were taken of the same finger in different positions. The creeping eruption was produced experimentally with a nematode larva obtained in culture from a dog. See explanatory item in these columns as well as other illustrations on the opposite page

the meantime, attempts have been made to find how the organism is transmitted from one human being to another. Both dogs and cats were found to harbor the larvae.

Volunteers were obtained who permitted themselves to be inoculated with larvae from the dog, and within 12 hours the disease was produced in the human being. In fact, larvae from both the dog and the cat were found capable of causing the disease in human beings. Among other names that have been applied to this condition is "ground itch." Not only the larvae mentioned, but also certain fly larvae and other parasites may produce forms of creeping eruption. The condition once discovered is easily controlled by causing the death of the infesting organism.

Metals in Food

OF late there has been much misinformation disseminated by competing manufacturers of kitchenware and by unreliable periodicals in the field of dietetics relative to possible dangers from dissolved metallic substances in food. In order to provide a scientific answer to the question of such dangers Drs. F. B. Flinn and J. M. Inouye of New York, made an investigation with scientific controls. They point out that copper, zinc, manganese, iron, and aluminum are to be found in plant and sea foods in appreciable quantities, that traces of nickel and cobalt are often detected, while lead is practically unknown in nature, except when waters have been contaminated by refuse from some industrial plant.

The metals commonly used in manufacturing cooking utensils are iron, copper, tin, aluminum, and nickel. Zinc is not used because it is easily acted on by weak acids and cases are on record of poisoning from eating food that has stood in galvanized vessels. Copper, aluminum, and nickel are all acted on to some extent by alkalinization or acids contained in food. Aluminum is only slightly attacked by organic acids and readily acted on by alkalies. Tin is most innocuous, but so expensive that it is seldom used for kitchenware.

ANOTHER ERUPTION

Eight days after inoculation with larvae from a pure culture of Ancylostoma braziliense *obtained from a dog*

The question to be answered by the investigation was whether or not a sufficient amount of the metals may pass into foods during the cooking process to act as poisons. It was found that the foods ingested with the metals reduced and modified the effect of the metal. Animals refused food having too metallic a taste so that some of the metals had to be given by stomach tubes or in capsules.

LARVA RESPONSIBLE FOR CREEPING ERUPTION

Other forms of the skin disturbance may be produced by other parasites

Copper, zinc, and nickel are so readily soluble in the acids of fruits, that it was considered inadvisable to recommend their use indiscriminately in vessels for cooking purposes. If the utensils are not kept scrupulously clean salts of the metal will form on the surface and these salts are more soluble than the metals themselves.

It is known that zinc, copper, manganese, aluminum, and tin are regularly found in the human body, although the exact functions of aluminum, tin, and nickel have not apparently been worked out. It was found that most of the metals taken in are promptly passed out of the body in the digestive process. There was no great accumulation of the substances even after three months' exposure.

With relation to aluminum particularly, the authors are convinced that the amount of aluminum taken in does not affect the body, particularly in the germ cells, in any way. There was no evidence that the aluminum replaced the iron in the blood or liver and there was not the slightest scientific evidence of any chronic poisoning taking place from food cooked in aluminum utensils. Large doses of aluminum salts, like copper and nickel, will cause disturbances of digestion, but such excessive doses as would be necessary to bring about such disturbances in the human body simply do not come into the body from the use of cooking utensils.

Women's Wear and Health

GEHEIMRAT RUBNER is one of the leading physiologists of Germany. In a recent statement he has condemned present-day dress of women because of its disastrous unhygienic effects. He points out that the mortality rates for women between the ages of 20 to 26 are increasing all over the world, particularly as relates to tuberculosis. He feels that the light clothing and the resultant chilling of the body associated with loss of body weight because of the craze for slenderization are the primary factors. Indeed, he says that if these youthful forms, which are nothing but skin and bones, were clothed in rags everybody would be shocked at the terrible social conditions.

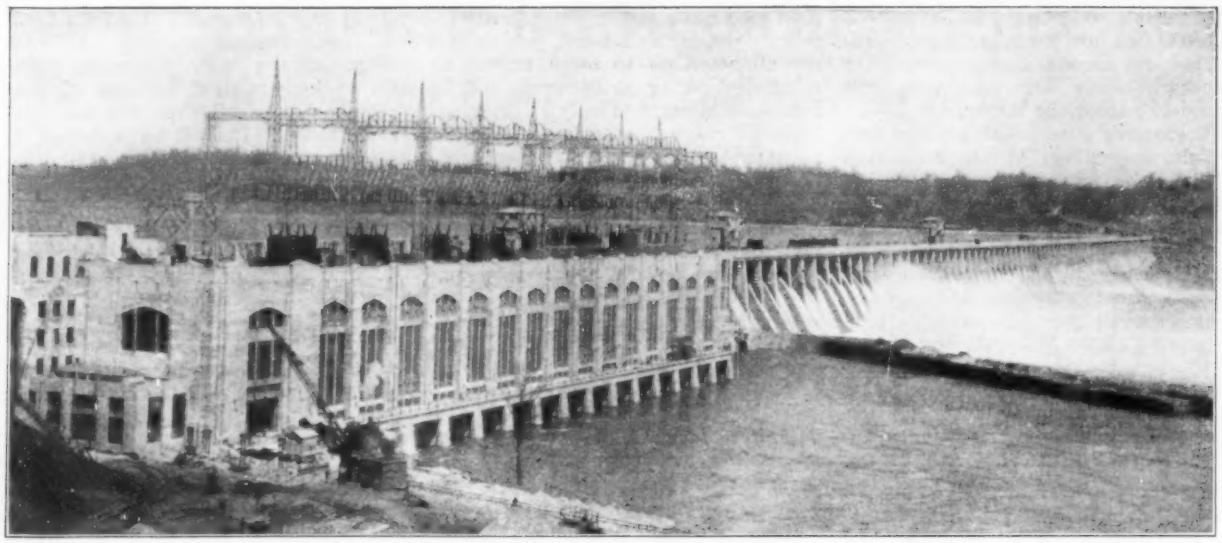
The clothing of women including shoes, weighed formerly from two and one half to three kilograms, or from five to six pounds. These figures have long since been left behind. Modern clothing weighs less than a pound, and even winter clothing weighs three and one half to four pounds. However, there is no longer, according to Rubner, any such thing as winter clothing, except for the outside coat. In fact, Rubner considers especially unhygienic the fact that underwear has diminished so rapidly that the outer garment, which is a single piece, and practically never washed, serves constantly as a direct covering for, and is in contact with, the skin.

Ptomaine Poisoning

ONCE upon a time everyone who developed any sort of illness after eating was reported as being incapacitated by ptomaine poisoning. In recent studies of outbreaks of such cases in the United States it was found that in almost one third of the cases the diagnosis of ptomaine poisoning had been made on first investigation.

Actually, ptomaines are compounds formed by the action of bacteria on nitrogenous matter. These substances are not at all poisonous as compared with the poisons given off by some bacteria, nor are they in any sense of the word specific poisons. Many bacteria which are not harmful to man may act on food to produce ptomaines, and many bacteria which are distinctly menacing to the human being do not produce ptomaines.

In most instances food poisoning is due to certain types of bacteria associated with food. These are either botulinus germs, which give out a highly poisonous by-product, or germs which have a joint affinity for the intestinal tract and produce various forms of intestinal disease. Food infected with such germs is far more dangerous than food which has merely decomposed due to the action of some bacteria associated with decomposition. If such cases are to be controlled from the sanitary point of view, it is necessary that a scientific diagnosis be made in each instance, and that the word "ptomaine" poisoning be avoided.



CONOWINGO HYDRO-ELECTRIC PLANT

This project is said to surpass Muscle Shoals and to rank second in the United States to that of the Niagara Falls Power Company. The dam is 200 feet longer than that at Muscle Shoals. The Baltimore Pike now crosses the river on a 20-foot roadway on top of the dam

Conowingo—Huge Hydroelectric Plant

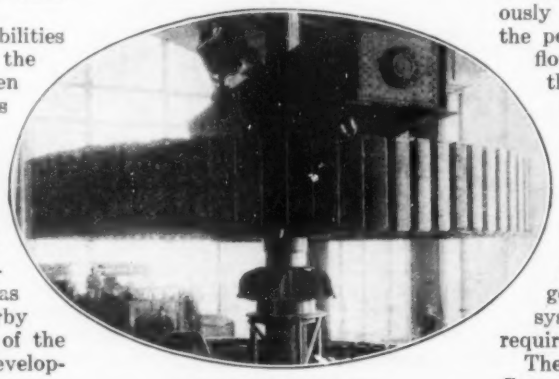
New Development On the Susquehanna River in Maryland Possesses Several "World's Largest" Features

By A. G. CHERRY
Engineer, Hydraulic Division, Stone and Webster, Inc.

ON the first day of March of this year, thousands of horsepower of electrical energy were sent flashing over the 60-odd miles of transmission line to Philadelphia from the first two generating units of the large hydroelectric plant on the Susquehanna River near Conowingo, Maryland. This date is a little less than two years after construction was started and is three months earlier than the scheduled date of completion of the first unit which was June 1, 1928. In fact, all seven units of the initial installation were completed June 1, six months ahead of scheduled time.

FOR many years, the possibilities for power development in the vicinity of Conowingo have been known and have at various times been investigated by engineers. Previous to 1884, however, the use of the power available was confined to small grist and lumber mills. In that year, an act of the Maryland Legislature authorized a power development at the site but it was not until recently that the nearby markets could absorb enough of the power available to make the development financially practicable.

The Susquehanna River above Conowingo drains an area of about 27,000 square miles, including almost one half the area of Pennsylvania and about one eighth of New York state. In the last 27 miles of its travel to tidewater, it drops almost 165 feet. Approximately 90 feet of this drop is utilized by the Conowingo development. The flow of the river is so variable that it is called "flashy." The minimum flow recorded is only 2,200 cubic feet of water per second, while the maximum on record is approximately 750,000 cubic feet per second. Between these two limits, the flow is extremely variable not only from day to day, but from week to week, and from season to season throughout the year.



PLACING A ROTOR

This rotor of one of the generators, together with its shaft, weighs 608,650 pounds

NATURALLY, with such a variation in river flow, the amount of power which can be generated will vary periodically. The only economical manner in which these varying amounts of energy can be used to serve the more constant demands of the power market is by co-ordinating the water power with the output of a steam electric system. With such a combination, the water power-plant is so operated that, during periods of plentiful water supply, the units are run continuously to carry the "base" load of the power system, while during low flow periods, the water is stored for the greater part of each 24 hours and is then released at a high rate of flow for the short time required to furnish the power for the daily "peak" load period. Conowingo is interconnected with the steam electric system of the Philadelphia Electric Company which, together with its associated power systems, furnishes the co-ordination required to absorb the water power.

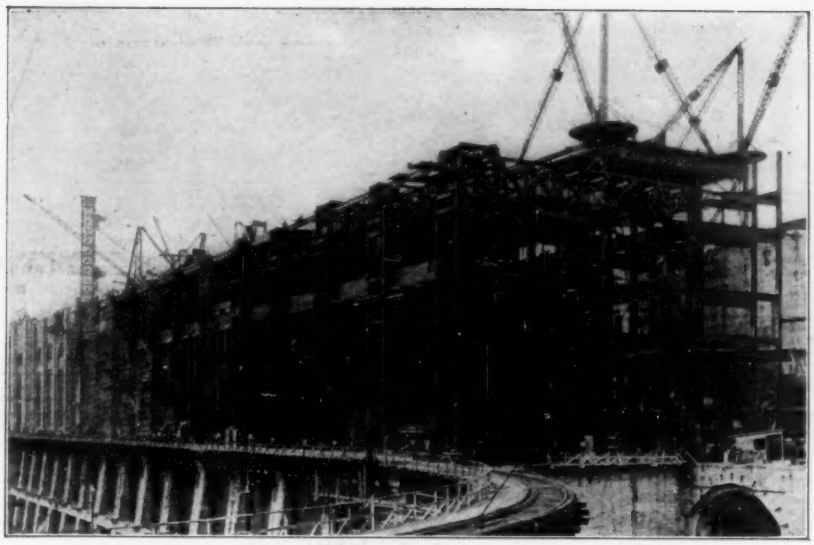
The dam and power station of the Conowingo development are located about 12 miles above the mouth of the Susquehanna River and about four

miles above the limit of tidewater in the river.

The reservoir formed by the dam extends nearly 15 miles upstream and is over a mile wide at many points. Submerged beneath its waters, lie miles of the Columbia and Port Deposit branch of the Pennsylvania Railroad, the site of the entire old town of Conowingo, the mile-long bridge which carried the Baltimore Pike across the river, and many other buildings, structures, and highways of lesser importance.

THE dam, which is nearly a mile in total length, is of the gravity type, built of mass concrete, and is divided into three general sections. It contains, exclusive of the power station head-works, approximately 430,000 cubic yards of concrete. The spillway or over-flow section, 2385 feet long, occupies the center section; the power station headworks takes up 950 feet adjacent to the west bank; while the remainder of the length, principally on the east side of the river, is filled by the bulkhead, or abutment, section.

The spillway section is designed to pass a flood over 10 percent in excess of the largest flood on record without raising the level above the normal. To accomplish this, the spillway is provided with 50 steel crest gates, each 22 feet, six inches high, with a span of 41 feet, and weighing about 42 tons. For minor regulation of reservoir levels, three additional gates of the same span but only 10 feet high, are provided. All these gates are raised and lowered by 60-ton cranes, three of which travel on a 20-foot gage track on a bridge over the dam. Electric heaters are provided to keep the gate guides clear of ice in winter and compressed air is released under water in front of each gate to prevent the formation of surface ice.



EXTERIOR OF THE POWER HOUSE DURING CONSTRUCTION

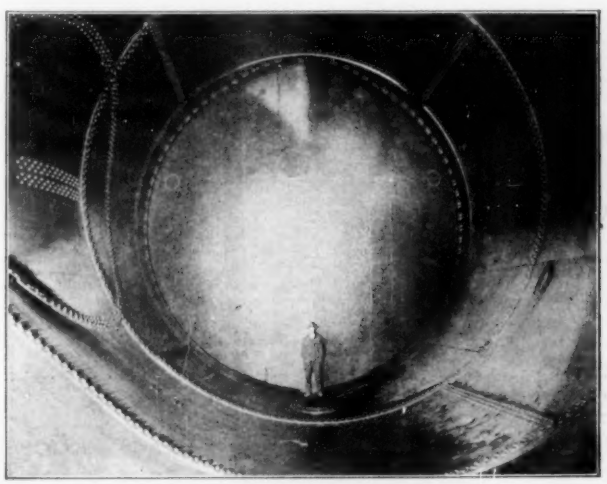
Looking toward the west bank of the river from below the dam. Steel and other materials were brought to the job by rail on the road shown here braced to the side of the building

The present development provides seven main water-wheel units of 54,000 horse power capacity each, or a total installed capacity of 378,000 horsepower, which is the largest amount of power, either steam or water, that has ever been installed at one time in a single plant. The ultimate development of the site calls for four additional units of approximately the same capacity, and the headworks section of the dam has been so constructed that these units may be installed whenever the additional capacity is required.

The over-all dimensions of the present power station section, including the headworks, are as follows: length 662 feet, width 176 feet, and height to top of switching structure on the roof 210 feet. The length of the power station when completed for the eleven units will be 950 feet.

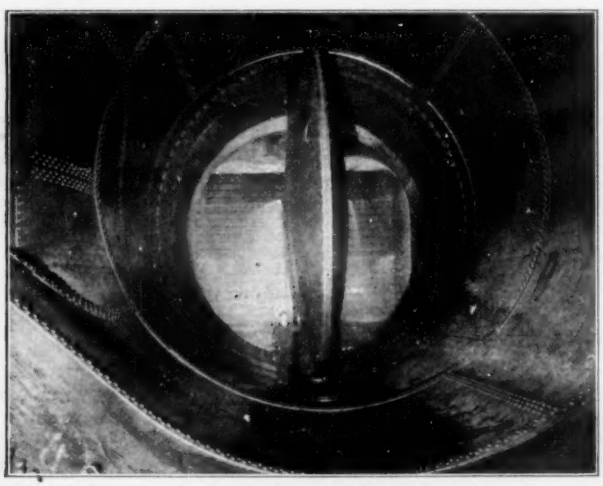
The power house is divided laterally into three general divisions: the generating bay, electrical bay, and headworks or intake. In addition, space is provided for machine shops, offices, storerooms, assembly and dismantling area for large equipment, and space for various other necessary auxiliary equipment. The 220,000-volt switching station covers nearly the entire area of the power station roof.

THE headworks section is designed as a continuation of the dam and contains the intakes to the water-wheel units. There are two intake openings 22 feet wide by 43 feet high for each main unit. By gradual transition these rectangular openings merge into a single circular water passage 27 feet in diameter at the entrance to the water wheels. The intake openings are protected from trash by sectional steel racks which can be cleared of any



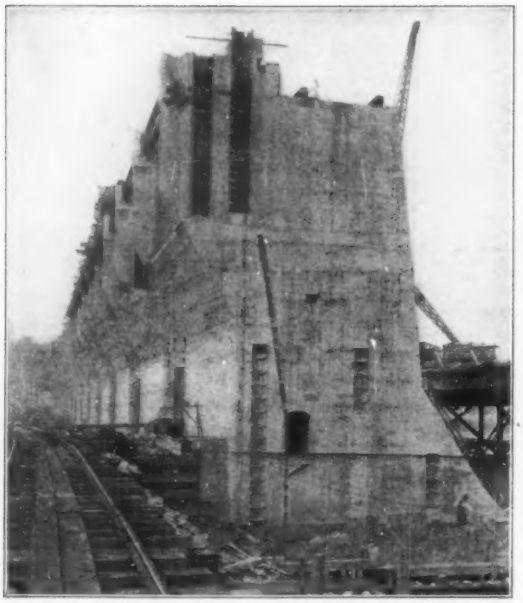
THE BUTTERFLY VALVE CLOSED

The largest ever constructed, one of these vertical-shaft pivot valves regulates the flow of water from the intake to each water-wheel case



LIKE A STOVE-PIPE DAMPER

In the open position. The entrance to the wheel here is 27 feet in diameter. The valve disk, operated hydraulically, weighs 135 tons



DAM SPILLWAY SECTION

An early stage in the construction of the dam, from the upstream side, with temporary railroads above and below

accumulation by a motor-driven raking device. Provision is also made for the intake openings to be closed by lowering steel sectional head gates in front of them. These head gates are handled by the same gantry cranes that operate the gates on the dam.

The generating bay, as its name signifies, houses the seven main generating units. The water wheels have a rated full gate capacity of 54,000 horsepower under the normal head of 89 feet and revolve at 81.8 revolutions per minute. Each wheel requires approximately 6000 cubic feet, or 375,000 pounds of water per second, to develop the full power. The units which are the largest in physical size in the world, are of the vertical shaft type and have plate steel spiral scroll cases.

TO regulate the flow of water from the reservoir to each water wheel, a vertical-shaft pivot valve called a butterfly valve, is placed between the lower end of the intake and the entrance to each water wheel scroll case. These valves, which operate in much the same manner as the common stove-pipe damper, are by far the largest ever constructed, being 27 feet in diameter. Each disk alone weighs about 270,000 pounds and when closed against the pressure of water in the reservoir, must withstand a thrust of about 3,000,000 pounds. The valves are hydraulically operated, using oil under 175 pounds pressure per square inch. Four of the water-wheel units with valves, were furnished by the Allis-Chalmers Manufacturing Company of Milwaukee, and the remaining three by the I. P. Morris Corporation of Philadelphia.

Connected directly to these water wheels are the seven main generators, each of 40,000 kilo-volt-ampere capacity at .90 power factor, and generating electrical energy at 13,800 volts. The outside diameter of each of these huge machines is 37 feet, while the rotating part is about 33 feet in diameter, and weighs over 250 tons. This weight, together with the rotating parts of the water wheel and the thrust of the water passing through the wheel, totals about 600 tons, or the equivalent of two of the country's largest locomotives, and is all supported by a single thrust bearing 80 inches in diameter, located near the top of the generator bearings. The unit is held in alignment by two babbitted guide bearings on the generator shaft and one adjustable bearing made from lignum vitae wood, on the water-wheel shaft, the latter being water lubricated.

A motor-driven fan is provided to cool each generator by drawing about 100,000 cubic feet of air through the machine every minute. Each main generator has a direct-connected 715 kilo-volt-ampere auxiliary generator, which furnishes energy at 480 volts for operating the motor-driven exciter, governor oil pump, and vent fan of that unit.

FOUR of the main generators were manufactured by the General Electric Company and three by the Westinghouse Electric and Manufacturing Company.

In addition, two separate station service water-wheel-driven generating units of 1900 horse-power each, are installed to furnish power for station lighting, crane operation and various other auxiliary services. The water wheels for these units were constructed by the S. Morgan Smith Company of York, Pennsylvania, and the direct connected generators are of Westinghouse Electric and Manufacturing Company make.

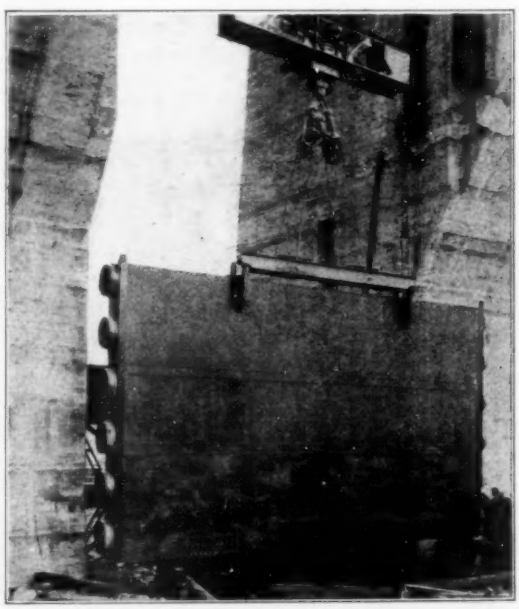
There are two main floor levels in the generating bay. The auxiliary equipment is, for the most part, located on the lower, while the upper is the main operating floor. A balcony provides access to the generators, and supports the motor-driven exciter units.

The electrical bay contains the low-tension bus structure and equipment, the main and station service transformer banks, the main control equipment, et cetera, including ten 13,800 volt oil circuit breakers.

The switching station on the roof, which possesses seven 220,000 volt oil circuit breakers, distributes the power after it has been stepped-up to 220,000 volts by the main transformers, to two transmission lines protected by two 220,000 volt lightning arresters.

FROM the switching station, the transmission lines cross the river below the dam in two spans of 1500 feet and 2300 feet respectively, being supported by four river-crossing towers of structural steel about 228 feet high. The power is carried over 58 miles of double-circuit transmission line to the large switching station at Plymouth Meeting, Pennsylvania, on the outskirts of Philadelphia, where it is stepped-down to 66,000 volts and distributed through the various sub-stations and plants of the Philadelphia Electric Company's system. The Plymouth Meeting sub-station, covering an area of 40 acres and controlling 750,000 kilowatts of electrical energy, will be the largest switching station in the world.

The engineering and construction operations have been carried out under the supervision of the Chief Engineer of the Philadelphia Electric Company, by Stone and Webster, Inc., of Boston, who associated with themselves in the construction of the dam, The Arundel Corporation of Baltimore. The Conowingo switching station and transmission lines were designed and constructed by Day and Zimmermann, Inc., of Philadelphia.



PLACING SERVICE GATE

Fifty of these gates, 22 feet high and 41 feet wide, and weighing about 42 tons, were installed on the spillway

EXTERIOR OF THE DINER

A general outside view of the de luxe motor dining car, and its "advance" or advertising car. The bus chassis and motor were carefully selected for safety of operation and for efficiency. A Hall-Scott engine, mounted in a Fageol safety coach, furnishes the motive power

The "Lunch Wagon" *Modernized*

BUILT for the purposes of food demonstrating, food and beverage advertising in general, and for dining, the motor bus illustrated in these columns is equipped with many unusual features—unusual, that is, for a mobile unit of its kind.

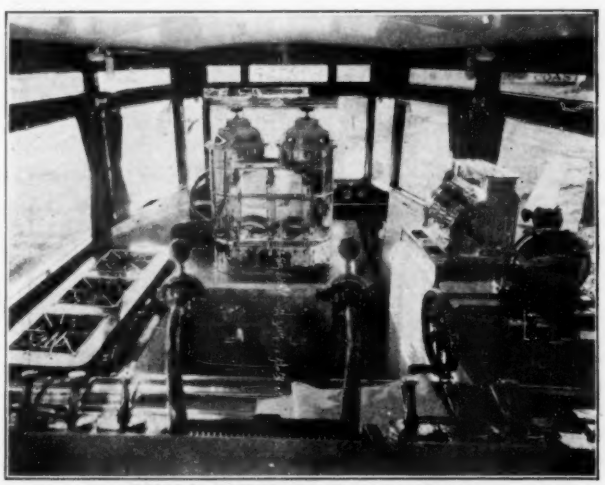
In the forward end, as illustrated, there is a complete up-to-date kitchen. Under the soda fountain at the service counter, there is an electrical refrigerating plant, operated from a portable generating unit. The latter also serves the lighting and other electrical equipment. The entire kitchen compartment is floored with tile.

The sanitary arrangements are very complete, comprising a small marine type schooner lavatory.

As a motor bus, the "Oasis," as it is called, has proved to be completely roadworthy. A trip from Philadelphia to Florida, and back to Atlantic City, was made without motor or tire trouble during the entire journey.

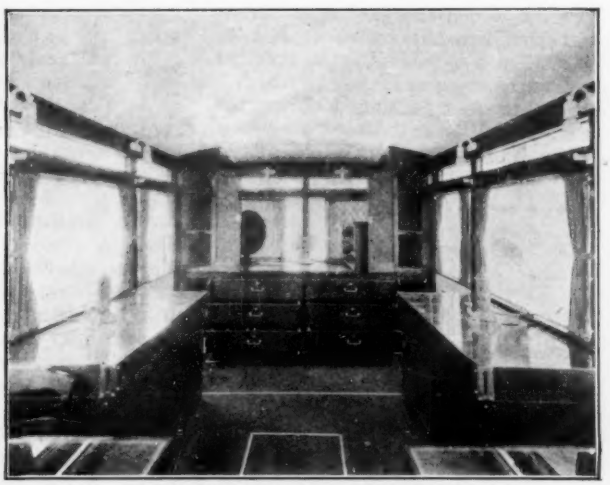
"LUNCHEON IS SERVED"

The interior of the luxurious motor dining coach, looking toward the driver's place, which is beyond the "kitchen." Tables can be used in either of the positions shown in the photograph



CLOSE VIEW OF THE KITCHEN

In the foreground is a completely equipped soda fountain, at the right is a meat slicer, at the left a stove, and in center is the coffee urn



LOOKING TOWARD THE REAR

In the background may be seen ample drawers for supplies and the like. Long windows all around furnish an abundance of sun-light

A MIMBRENO

One of the mummified figures which were found buried under the floors of the houses

Who Were the *Prehistoric Mimbrenos* of New Mexico?

Evidences of a Peculiar People Whose Culture Differed from that of the Other Early Inhabitants of the Southwest

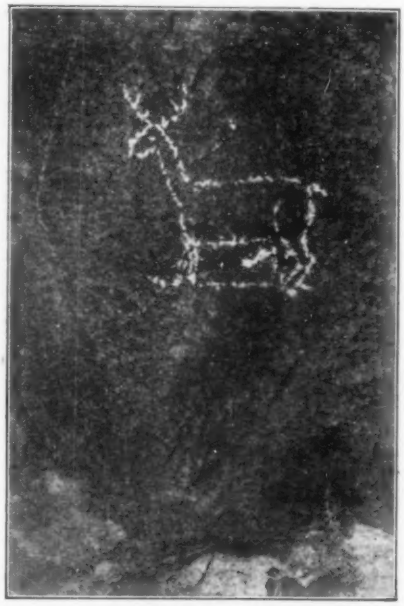
By GEORGE A. WALLIS

A PREHISTORIC civilization, distinct from that of the Pueblos and the cliff-dwellers, has been opened up by recent research along the Mimbres River in southwestern New Mexico. Excavations made in this region have brought to light an ancient race whose customs, arts, and architecture, were different from any of the other semi-civilized people who once inhabited much of the southwest.

Very little was known about this region until it was visited in 1923 by J. Walter Fewkes who made a collection of the pottery and implements of the people for the United States National Museum. Most of this collection was purchased from ranchers and other residents of the country who had gradually collected the articles from the numerous ruins scattered throughout the Mimbres valley.

SOON after Mr. Fewkes visited the region, the New Mexico State Museum and the Peabody Museum sent expeditions to southwestern New Mexico, and the work of excavating some of the ruins was started. This research has been continued during the summer months for the last three years. Although only two of the ancient cities have been scientifically excavated, enough has been learned about the inhabitants to show that they were a distinct nationality and apparently antedated both the Pueblos and the cliff-dwellers.

Southwestern New Mexico is a mixture of mountains and wind-swept desert. Rising in the mountains and flowing southward is the Mimbres River, a small stream fringed with willows. A short distance north of Deming, New Mexico, it is swallowed up by the desert sands; although during rare intervals of flood, its waters reach Palomas Lake in Chihuahua, Mexico. The ancient ruins are found all along the banks of the Mimbres and its tributaries, wherever cultivatable land is found. The villages range from farm sites with a half dozen buildings to towns of three or four hundred buildings. Water and farm land seem to have been the deciding factors in selecting the sites for their cities. Many of the villages are found in level valleys; and, unlike the cliff-dwellings and Pueblos, show no desire on the part of the inhabitants for defensive locations for their homes.



A PICTOGRAPH

Hundreds of fine paintings of this type have been found on the cliffs of the southwest

The typical Mimbreno house is a rectangular room of not more than 12 by 14 feet. These buildings may be isolated or joined together in small groups. Most of the houses were built of stone and adobe. Many of the houses were partially underground with walls and roofs rising only a few feet above the surface of the earth. The buildings were entered from the side and not through an opening in the roof, as is the case with the Pueblo dwellings. These entrances were almost always located on the south or east side of the houses and were probably made there in order to admit the maximum amount of sunlight. Fire pits are found near the center of the rooms; the smoke apparently found its way out through a hole in the roof.

THE ruins are in a poor state of preservation and nowhere rise above the surface of the earth. Piles of tumbled down stones mark the site of the buildings, and the walls can be traced by shoveling away the sand that has been accumulating about them through the ages. The walls are of rough stone, held together by adobe mortar. Heavy cedar beams which

EXQUISITE POTTERY

The Mimbrenos were expert potters. Who but an expert could make such a bowl?

THIN AND DELICATE

A closer view of a basin shown in the group to the right on the opposite page

once supported the roofs can still be found in places where they have been protected from moisture.

The Mimbrenos were an agricultural people. Ears of Indian corn, which were preserved by being half burned and charred, have been found in dry places in the ruins. Numerous pestles and *metates* found in every ruin attest to the large amount of grain ground.

The Mimbrenos were unexcelled as potters, and the inside of their bowls and the outside of their pitchers and vases are beautifully decorated. Pictures of deer, mountain sheep, antelope, bear, turkey, quail, and rabbits are painted on the Mimbreno ware with a realistic skill unequaled by any of the other ancient inhabitants of the southwest. Drawings of fish show that there were fish in the shallow waters of the Mimbres River. Besides the drawings of animals, the ware is decorated with hundreds of beautiful geometrical designs. The figures are in black or brown on a white background. The worn bottoms of the vessels indicate considerable use.

ASIDE from the practical use of the pottery in the daily life of the people, it had an important place in the burial ceremonies. Some pottery is found in nearly every grave; and a bowl, with a small hole broken in the bottom for the occasion, is usually found placed over the head of the skeleton.

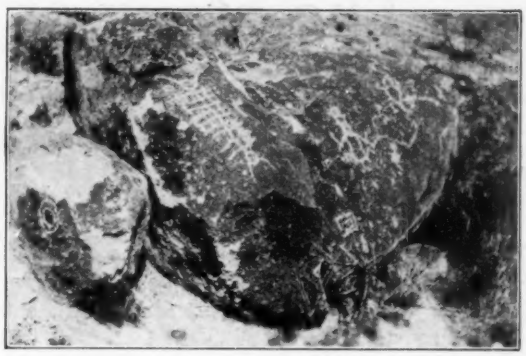
The dead were buried under the floors of the houses in the corners of the rooms. The limbs of the deceased were sometimes extended but more often flexed. The aridness of the region has helped a great deal in preserving skeletons of these people who disappeared centuries ago. A general flatness at the back of the skulls suggests that the babies were strapped to a board not unlike the way in which other tribes of Indians are known to have carried their young.

SIGNIFYING WHAT?

What these pictographs mean is unknown. Possibly they do not all have significance

PICTOGRAPHS

Drawings made on the rocks, whether by pigments or etching or both, were left by the American Indians in a host of places in the west. They were an attempt at writing and in many cases their meaning may be deciphered. Some of them are fanciful; for example, those which, resembling a dinosaur, caused a real stir in the west not long ago



Hundreds of fine pictographs portraying the customs and traditions of the people have been found on the cliffs near their homes. Some of these are painted in colors that have endured through the ages. Others are carved in basalt and sandstone.

The large number of beads and bracelets made from sea shells indicate that the Mimbrenos carried on trade with tribes living on the coast. In 1925, Mr. E. R. Eisele of Fort Bayard, New Mexico, found a small copper bell in a ruin near Hanover, New Mexico; and since that time several others have been found. The exact origin of the bells has not been determined, but they suggest that the Mimbrenos may have been in communication with the copper-working tribes of Mexico. The bells are, so far, the only metal objects found. And although these people lived in a region where copper is now being mined from open pits with the use of steam shovels, there is nothing to indicate that they understood the working of metals.

NO circular, underground *kivas* like those of the Pueblos and cliff-dwellers have been found; although a rectangular room 25 by 30 feet, constructed underground and no doubt used for ceremonial purposes, was found in the Cameron Creek ruin, which was excavated in 1925 by the New Mexico State Museum. The absence of the *kivas* and the isolation of the buildings of the Mimbrenos, show a lack of relation to the cliff-dwellers and the Pueblos.

A few villages which have been identified as belonging to the Casa Grande people of Mexico have been found among the Mimbreno towns along the lower course of the Mimbres River. The villages are easily distinguished by comparing the pottery. Mimbreno towns which were abandoned and later occupied by the Lower Gila people of Arizona have been found. That the houses were built by the Mimbrenos is evident from the pieces of broken Mimbreno pottery found in the adobe walls. The later occupation of the buildings by the Lower Gila people is shown by the pieces of Gila pottery found in the floors and around the buildings but nowhere in the above walls. This tends to prove that the Mimbrenos were contemporaneous with or older than the prehistoric, city-building people of southern Arizona.

MORE POTTERY

The delicacy and thinness of the work and the fine designs on its surface are notable

The difference in the architecture and the absence of the round *kiva* shows that the Mimbrenos were not influenced by the wide-spread Pueblo and cliff-dwelling culture of the southwest. This, together with the poor condition of the Mimbreno ruins, has led archeologists to believe that the Mimbrenos preceded these people. The Mimbreno ruins nowhere rise above the surface of the ground, while pueblos and cliff-dwellings are still to be found in a good state of preservation.

Just when the Mimbrenos came into the country and why they disappeared is uncertain, but they were apparently absorbed or exterminated by the savages. No great number of spear and arrow heads are found in the Mimbreno ruins. This suggests that they were not a war-like people and were likely to fall victims of invading tribes. The nomadic Apaches occupied the country when it was first explored by the Spaniards.

The Story of the Shade Roller

Five Factories and Two Thousand Employees Today Are Kept Busy Producing the Spring-Operated Window-Shades Which Stewart Hartshorn Patented in 1864

By MILTON WRIGHT

YEARS ago, long before the Civil War, a little boy had a strange desire. He would build a city. It would be not a mere collection of buildings of all sorts with stores and offices and factories set up each according to the whim of a different owner, but it would all be planned by the little boy. There would be no factories, no stores, but only homes, stately homes of stone, each strikingly individual, yet harmonizing with its neighbors. There would be no straight, hard streets, but winding roads, tree-shaded. It would be a dwelling place of beauty.

Between that desire and its realization is a wide chasm of years. It must be bridged, and it is of the bridging we would speak—of those years of business activity in which a fortune was made from a little invention, years in which the name of Stewart Hartshorn became a household word in a very literal sense, years in which windows throughout the length and breadth of the nation were fitted with the invented article—the spring shade roller.

TO learn the story of the invention we sat with Stewart Hartshorn in his New York office.

"How did you come to invent the spring roller for window shades?" was our first question.

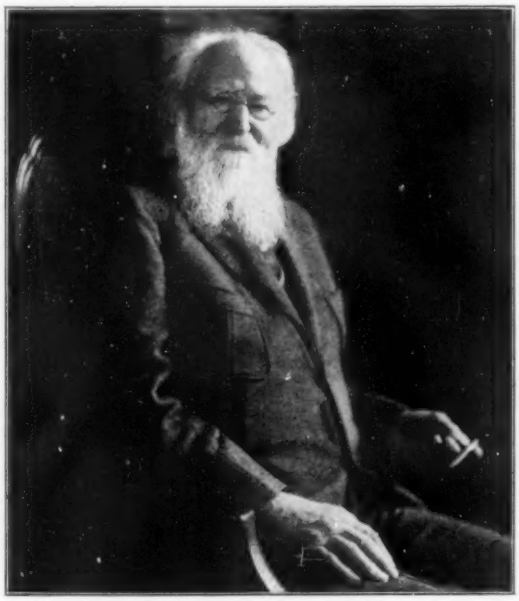
"I was in the window-shade business," he replied.

"Then the business was not founded on the invention?"

"No. The invention grew out of the business. My father, Jacob Hartshorn, and his half-brother, John, had bought a patent for a spring shade as early as 1848, and they made shades according to it, but they were not practical. In 1855, they devised a different one and took out a patent. It was not greatly different in principle from the roller we have today, except that they put the pawl, or catch, on the bracket instead of on the roller.

"My father died in 1859 and I shouldered the burden of carrying on the business. It wasn't much of a business, as far as size went. I would get an order from a householder or store-keeper for window shades, measure the windows, make the shades, put on rollers and place them on the windows. When business was especially good I had one man to help me.

"Now it seemed to me that window shades that rolled up and down were not as convenient as they should be. They got out of order easily and there were strings which were always getting in the way of the side of the window or with the curtains or draperies. Why not, I asked myself, have the shade roller operable by power within itself rather than by pulleys or balances outside the roller where they are in the way.



A PHILOSOPHER NOW

"The inventor must have as his object an invention that is good," says Hartshorn. "Then money may follow"

"On the face of it my idea seemed impracticable. I had two principles with which to work—gravity and centrifugal action. I could pull down the shade and release the ratchet or pawl, and then let go. The spring would pull it up immediately and the pawl would not have time to drop into the notch and hold the shade down at the desired height. If I let go slowly, however, it would work. By experimenting I finally arrived at the present principle—controlling the action of the shade roller through the roller itself—a principle which has never been altered. In 1864 I took out my first patent on a practical shade roller."

"Have you ever been called upon to defend that patent?"

"Yes, indeed. A successful invention means lawsuits. I went through a number of such experiences; they would keep on developing from time to time as long as the life of the patent endured. In every case, however, the judges decided in my favor and the validity of the patent was established beyond question."

"Did you try to get someone to take your patent off your hands either by outright purchase or on a royalty basis?"

"No, although I know that is the ordinary disposition. Most inventors try to make their money by selling their patents, but I stuck to the idea of developing the invention and the business myself. After I had perfected the new type of roller shade, I still did the whole job myself—getting contracts to fit up windows, getting shades, combining them with rollers, hanging them up and so on. There was some difficulty in getting people to see the advantage of the new kind of shade roller—there always is difficulty in getting people to adopt something new—but the resistance began to wear away in time.

"THE next step in developing the business was to get the upholsterers to use my invention. I was not then distributing throughout the country, but only in and around New York. Steadily the business grew and with it there were not only increasing complexities of business procedure, but endless details in improving and perfecting the shade itself.

"In about three years imitators began to appear, for by that time the business had grown to a point where it became an object of interest to others. Rival shade makers began to make a roller like mine and I employed a well-known lawyer to stop them. This sort of thing was repeated over and over again for years. My patent, by the way, was one of the first to run for seventeen years. Prior to that time the life of a patent was fourteen years, but just before mine was granted

the law was changed and the longer period provided for."

How many millions of shade rollers have been on the Hartshorn principle is a matter of the wildest speculation. Today his company employs about two thousand workers. Five factories are in continuous operation, one at Newark, N. J., devoting its entire output to steel wire, one at Muskegon, Mich., making rollers both wood and metal, one at Toronto, Canada, also making rollers, one at Goldville, S. C., where cotton is spun and woven, and one at Oswego, N. Y., for the finishing of shade cloth. When the whole world goes to bed at night it pulls down the shades on a Hartshorn type of roller.

Surely the inventor of such a product would have a word of advice helpful to other inventors, we thought. We determined to ask him.

"Mr. Hartshorn," we said, "what suggestion would you make from your experience to other inventors whose success is yet to be achieved?"

"Well," he replied with a smile, "I would suggest that they let shade rollers alone."

"Why? Have you noticed that inventors have any tendency to go in for shade rollers?"

"Yes, indeed. About one a week is submitted to us. None of them we think practical. In thirty years only one that has been brought in here has seemed to have any value, and that one was so closely paralleled by another developed just about the same time, that the similarity was fatal for both parties.

"TO be practical is the best advice I can give inventors. Many an impractical invention is made and patented, only to rest in obscurity on the shelves of the Patent Office, with the inventor having spent time and money and energy for nothing. Years later such an invention comes to light and is cited against a really worth while invention for which a patent is being sought. The multiplicity of clauses and claims in such patents makes it almost vain to try to cover adequately and validly an invention that is useful.

"Frequently inventors go in for something they know nothing about. In their ignorance of the state of the art their enthusiasm leads them to think they have something new. Great is their surprise when they learn that hundreds of others have been doing the very thing they have been working on."

"Have you ever tried inventing outside of the shade roller field?"

"O, yes. After the Civil War, when all the slaves had been freed, it was felt there was a great demand for a mechanical cotton picker. I tried my hand at it. I got balls of cotton from the south and I evolved a machine that would work to a limited degree. When I applied for a patent an interference was declared with an inventor in Texas and one in Brooklyn. The Texas man's was somewhat like mine in principle; it had a device like an elephant's trunk to reach out and suck up the balls; my machine straddled the rows and sucked them up.

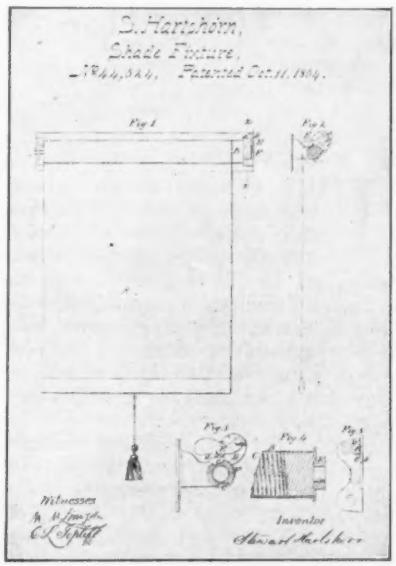
"SOME of the ideas I had were at least original. I remember observing that people were accustomed to walk faster in cool weather than in hot weather. From this observation I proposed to apply the bellows principle to the soles of shoes with a tube system running under the clothing, so that the faster a person walked the cooler he would be."

"Did you patent that invention?" we asked.

"Not yet," he laughed. "It was just one of those things. Firearms were something else I became interested in; they have intrigued lots of us. I was deeply interested in working out a new kind of cannon at one time. A cannon, I reasoned, takes a lot of metal. I'll make a gun that won't have the bullet inside, but I'll have the projectile strung on a central rod, like a doughnut. I still had the breach to contend with but I could overcome that nicely. I could groove the rod the same as the barrel is grooved in an orthodox cannon. I made a wooden model of the invention. Eventually, however, I decided to give up the invention. The world had enough things to kill people without my adding something, I reflected. I was aided somewhat in reaching this philosophic conclusion by the fact that I couldn't get my bullet to leave the gun."

"These are the things every inventor will do and you can't stop him, try how you will."

"Mr. Hartshorn," we interrupted, "there is an old saying that necessity is the mother of invention. Would you say that an inventor is more likely to succeed if he is spurred on by the necessity for making money?"



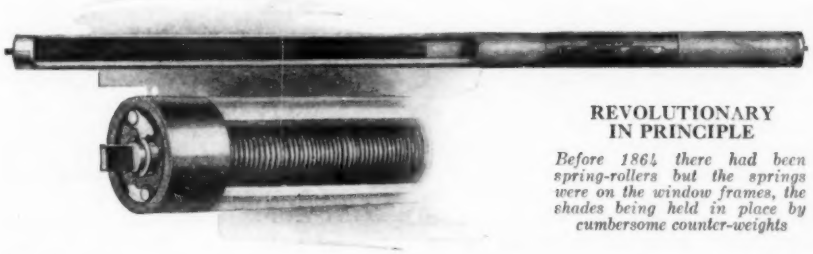
CALLED A "SHADE FIXTURE"

With a single claim this patent was involved in constant litigation but always won

"No. The moment a man is contriving something for the purpose of making money, the probability ceases that he will produce something with money-making possibilities. It's like one of those old violin makers. If he had been thinking of the money he was going to get he would not have turned out a priceless masterpiece. The inventor must have as his purpose the making of an invention that is good. Then money may follow.

"When it comes to the making of money from a good invention then you must feel your way as you go. An inventor or manufacturer is foolish if, in his enthusiasm, he turns out something new in great quantities, hoping to make a fortune in a hurry. A man can never know the full value of his invention until he tries to market the invented article. The public must decide the matter for him, and the decision will not be in his favor unless the invention is right."

AND so Stewart Hartshorn builded upon his invention the business and the fortune that made it possible to realize the ambition he had held as a boy—to plan and build an ideal home community. It is at Short Hills, New Jersey. Fifteen hundred acres it covers—the houses peeping above tree-shaded lawns set back from winding roads—a dwelling place of beauty destined to stand as an enduring memorial to the man who made an invention the world found worth-while.



REVOLUTIONARY IN PRINCIPLE

Before 1864 there had been spring-rollers but the springs were on the window frames, the shades being held in place by cumbersome counter-weights

The Origin of the Cosmic Ray

*Evidence for the Continuous Creation of the Common Elements Out of Positive and Negative Electrons, As Presented to the National Academy of Sciences**

By R. A. MILLIKAN and G. HARVEY CAMERON
Norman Bridge Laboratory of Physics, California Institute of Technology

THE evidence obtained from the study of cosmic rays that the more stable and more abundant elements like helium (abundant in the heavens), oxygen, silicon and iron, are being formed *at the present time* out of the primordial positive and negative electrons, the former of which is the nucleus of the hydrogen atom, may be briefly summarized as follows:

First. The pilot-balloon experiments of Millikan and Bowen[1], in which they sent up recording electroscopes 0.92 of the way to the top of the atmosphere and in which the absorption coefficient of the cosmic rays at, or near, the top of the atmosphere came out of the same order of magnitude as that found near sea-level[2], show conclusively that these rays consist of a definite and distinct region of spectral frequencies, or oscillations, a hundred times more rapid than those produced by the most powerful sub-atomic changes heretofore known, namely those accompanying radio-active processes.

OTHERWISE stated, these experiments show conclusively that there are no radiations of appreciable intensity entering the earth's atmosphere having frequencies intermediate between those of the gamma rays and those of the cosmic rays. For, since the hardest gamma rays are capable of penetrating a thickness of about 70 centimeters of water, while, as indicated below, the cosmic rays are capable of penetrating 70 meters of water, and since penetrating power increases approximately as frequency, if rays of appreciable intensity came into the atmosphere having frequencies between those of gamma rays and those of the cosmic rays they would of necessity have caused the rapid discharge of an electroscope which rose to within the equivalent of 80 centimeters of water of the top of the atmosphere, the whole of the earth's atmosphere being the equivalent of 10 meters of water. No such rapid discharge took place; hence there are no *strong* radiations entering the earth's atmosphere in that particular region of frequencies.

Second. The experiments of Millikan and Cameron of the last summer and fall made in deep, high-altitude California lakes, with new electroscopes eight times more sensitive than those the authors had theretofore used, brought to light the definite proof that the cosmic-ray spectrum consists of definite bands, like those of neon or mercury lamps, containing spectral lines as much as three octaves apart, the highest frequency band having so enormous a penetrating power that it passes through as much as 200 feet of water (18 feet of lead) before becoming completely absorbed.

This discovery of a banded structure in the cosmic rays shows that they are not produced, as are X rays, by the impact upon the atoms of matter of electrons which have

ELECTROSCOPE

When charged the filaments repel one another. Cosmic radiation discharges them

acquired large velocities by falling through powerful electrical fields as we earlier suggested[3]—the fields needed to produce frequencies of the order of the cosmic rays would be at least 150,000,000 volts—(3000 times as great as the field existing in X-ray tubes)—but that *they are rather produced by definite and continually recurring atomic transformations involving very much greater energy-changes than any occurring in radio-active processes.*

The proof of the banded strucure of the cosmic-ray spectrum is found in the fact that the new ionization-depth curve (Figure 1), when taken in connection with the sounding balloon data, which is seen to be of very much higher resclving power than any heretofore obtained, shows a nearly constant absorption coefficient from close to the top of the atmosphere down to about sea-level, 10 meters below the top, then bends quite suddenly and uncovers below 15 meters a new absorption coefficient, of only about one sixth the former value which continues down to 70 meters below the top with but little further change. The cosmic rays, therefore, consist of at least two, possibly more, (see below), radiation bands of absorption coefficients, (and therefore, roughly, also of frequencies) in the ratio 6 to 1. The sharpness of the bend in the ionization-depth curve is completely incompatible with any general distribution of the frequencies of cosmic rays, like that found in white light, or in the general X-radiation which is produced by the bombardment of the atoms of a target by high-speed electrons (cathode rays).

Third. If the Einstein special theory of relativity may be taken as a sound basis of reasoning—and no results predicted by it have ever thus far been shown to be incorrect, while it has many striking successes to its credit—then it follows that radiant energy can never escape from an atomic system without the disappearance of an equivalent amount of mass from that system, these relations being contained in the now well known and universally used equation of Einstein (1905) $Mc^2 = E$, where M is mass in grams, c is the velocity of light in centimeters per second, and E is energy in ergs.

NOW through the recent, very exact work of Aston[4] we know the mass of every one of the atoms with a great deal of certainty, and we can therefore compute the amount of ether-wave energy that can be generated by any sort of atomic transformation that can take place, and knowing this energy we can compute with the aid of the Einstein equation the frequency, and with the aid of the Dirac formula[5] the penetrating powers of the rays resulting from all possible atomic transformations. *Such studies reveal the fact that there are no possible transformations capable of yielding rays of the enormous penetrating power observed by Millikan and Cameron except those corresponding to the building up or creation of the abundant elements like helium, oxygen, silicon and iron out of hydrogen, or, in the case of the last two*

*Proceedings National Academy of Sciences, 14; 6
[1]Millikan and Bowen, Phys. Rev., *22*, 198 (1923) and Phys. Rev. *27*, 353 (1926)
[2]Millikan and Cameron, Phys. Rev. *31*, 163 (1928)
[3]Millikan and Cameron, Nature, *121*, 24 (1928)
[4]Aston, Proc. Roy. Soc., *115*, 487 (1927)
[5]Dirac, Proc. Roy. Sec., *109*, 206 (1925)

elements we mentioned, out of helium.

The entire annihilation of hydrogen by the falling completely together of its positive and negative electrons might be an additional possibility, but it can be eliminated in this case for two excellent reasons. The first of these reasons is that there is practically no place whatever for such a radiation to occupy in the observed ionization-depth curve (see Figure 1), for it would be between four and five times more penetrating than the radiation that has the smallest absorption coefficient mentioned above. The ionization due to it, if it exists, would then have to be included in the 2.4 ions which represents the "zero of the electroscope" as shown in the figure. But this 2.4 ions is only about one tenth of the observed ionization at the top of the curve, viz. 21 ions, this topmost reading corresponding to a depth of 1 meter below the surface of Gem Lake. Therefore this hypothetical radiation can have nothing to do with the observed ionization-depth curve much above the reading 2.4, and below it there is of course room only for a radiation relatively negligible in intensity in comparison with the softer rays that are responsible for the observed curve.

The second reason is that this hypothetical radiation, if it were present, would of necessity be homogeneous, and could not therefore exhibit the banded structure shown by the observed cosmic rays. Whether, then, this act of the entire annihilation of the hydrogen atom through the coming into complete coincidence of the positive and negative electrons takes place or not, it can certainly be eliminated as a cause of the *observed* cosmic rays.

There remains, then, no other atomic transformation in which sufficient mass disappears to create the observed cosmic rays except the aforementioned *atom-building* processes.

IT is important to note that no step-by-step process of building up, or for that matter of disintegrating of atoms, in which one positive electron or one alpha particle is added or subtracted at a time, will suffice for the generation of the cosmic rays, since the Einstein equation tells us that in no case can such a transformation produce rays of more than from one fourth to one twenty-fifth of the observed penetrating power. The observed extraordinarily penetrating cosmic rays present, then, when taken in connection with Einstein's equation and Aston's findings, not only the first direct evidence that the more abundant elements *are now in process* of being created out of positive and negative electrons, but they also present the first indications as to the general character of the specific act or acts by which the atom-building process goes on.

So far we have used only the general or qualitative evidence, but it will be seen that from it alone the conclusion is scarcely escapable that the powerful cosmic rays here studied can be produced only by the creation *in a single act*, rather than by a step-by-step process, of some, at least, of the common elements out of the primordial positive and negative electrons.

Fourth. The evidence herewith obtained is, however, not merely qualitative but fairly accurately *quantitative.* For we analyzed very carefully our cosmic-ray curve empirically before we called on any theoretical considerations whatever to explain it, and we reported in scientific papers that our observed curve demanded three cosmic-ray bands of absorption coefficients 0.35, 0.08, and 0.04 per meter of water, respectively.

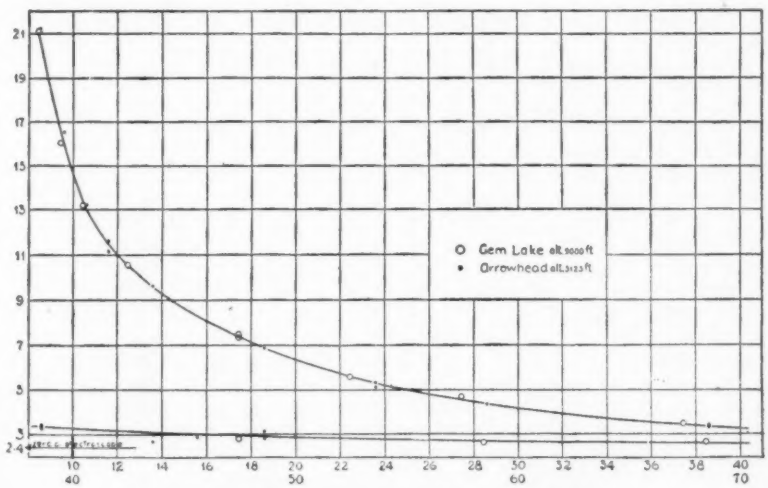
It was after this work had been done, reported in seminars, written up and prepared for publication in essentially the form in which it will appear[6], that we set about computing from the foregoing considerations what the theoretical absorption coefficients would be if our observed cosmic rays were produced (1) by the formation in one single act of helium out of hydrogen, (2) by the similar formation of oxygen out of hydrogen, and (3) by the formation of silicon out of hydrogen. The results of this computation came out 0.30, 0.075, and 0.043, well within the limits of the resolving power of our curve of the observed values.

Further, there are only a few elements so abundant that their formation needs to be considered as the possible source of the observed cosmic rays. For the spectroscopy of the heavens shows a very great abundance everywhere of the gases hydrogen, helium, and nebulium. But Bowen[7] has just identified the last as nitrogen and oxygen, so that these gaseous elements hydrogen, helium, nitrogen and oxygen seem to be extraordinarily widely spread through space.

As to elements found in solids the meteorites have 96 percent of their mass in the four elements, oxygen, magnesium, silicon and iron. Magnesium and silicon are close together in atomic weight, 24 and 28, respectively, so that their formation would constitute but one band, the mean energy of which lies approximately at mu 0.04. It was this joint band that we above called for convenience the silicon band.

SIMILARLY the atomic weights of nitrogen and oxygen are respectively 14 and 16, and the mean absorption coefficient 0.08 corresponds to this joint band. The helium band, most significant of all, corresponds to mu= .30. There is no other abundant element except iron, and the formation of this out of hydrogen gives a cosmic ray for which mu= 0.021. The existence of such a radiation helps rather than interferes with the fit of our theoretical and experimental curves, but on account of the lack of resolving power in the lower end of our curve it furnishes no trustworthy evidence that this particular act is the one by which iron is most commonly formed. This uncertainty does not exist, however, with respect to the bands corresponding to mu= 0.30, mu= 0.08, and mu= 0.04.

This whole work constitutes, then, very powerful evidence that the sort of creative, or atom-building, processes discussed above, are continually going on all about us; possibly also even on the earth, and that each such event is broadcast through the heavens in the form of the appropriate cosmic rays.



THE REVEALING IONIZATION CURVE

Figure 1: *If the spectrum were continuous instead of banded, the curve (of ionization against depth in equivalent meters beneath top of atmosphere) would show no sharp bends*

[6] Millikan and Cameron, Phys. Rev., June, 1928
[7] Bowen, Astrophys. Jour., 57, 1 (1928)

Photographs courtesy *Pictorial California*

IN A COACHELLA VALLEY DATE GARDEN

This view through the pleasantly shaded aisles of the garden serves to show the well developed cultural methods that are used. This section is 200 feet below sea-level. An area of 1500 acres is devoted to date palms, with a production of 1,355,000 pounds during the last year

Date Growing *in the* United States

Old World Planting Stock and American Cultural Methods Are Combined to Produce Large Crops

ALTHOUGH date palms were first planted in the southwest over 150 years ago, the date industry has taken on a commercial aspect only in recent years. The first successful importation of planting stock was made by the United States Department of Agriculture in 1900, and since that time, over 2000 acres of palms have been planted in California and Arizona. The industry centers in the Coachella Valley, a rich irrigated desert section below sea-level in Riverside County, California, where 90 percent of the plantings in the southwest have been made.

From time to time, enthusiastic writers striving for local color have attempted to picture the domestic date industry as an Old World activity transplanted bodily to a new setting. But this is far from true in a practical sense. Although a large proportion of the date palms now producing fruit were imported, the industry is now strictly American, for with the characteristic enterprise of the American pioneer, date growers of California have progressed farther in two decades than their contemporaries in some of the older date-growing countries have in as many centuries. Since present quarantine laws prohibit further importation of foreign planting stock except for experimental purposes, the two areas are completely divorced.

It is also in the handling of dates for market and the processing and packing of the fruit, that rapid strides have been made in California. Machine methods have been developed in packing house operations and domestic growers have stressed sanitation and attractive packageing. This is the contrast with the practices of the Old World growers who send their product into this country with a rather dubious sanitary history behind it.

THE report of the Riverside County Horticultural Commissioner showed that Coachella Valley marketed 1,355,000 pounds of dates in 1927, which returned growers around 15 cents a pound.

The propagation and culture of dates is a unique and most interesting horticultural operation. Few economic plants have seen such romantic development as has attended the growth of the date industry in the west. Many of the cultural practices have been evolved in California, although the fundamentals, of course, were brought from the established industries in the East. New methods have not only been developed by the growers themselves, but by the United States Department of Agriculture, which has maintained an experimental station in the Coachella Valley for many years.

Commercial date palms are propagated by means of "offshoots" which sprout from the trunk of the parent palm. The offshoot is really a bud in the axil of the leaf and, therefore, a direct product of the growing stem and of the same variety and characteristics as the mother palm. These offshoots are rooted on the parent palm and later removed with a sharp instrument for orchard or nursery row planting. Each palm will bear from six to 20 offshoots during its production period.

POLLENATION

Instead of depending on natural pollenation, date growers use an artificial procedure

With careful handling, offshoots set in orchard form will get a fair start the first year, and production will start during the fourth or fifth season after planting. However, palms do not come into full bearing until they have reached the age of seven or eight years. There is considerable variance in time of maturity among the better varieties of dates. The average production of a palm ten years old is from 100 to 200 pounds.

As the date palm is a dioecious plant, with male and female flowers being borne on different palms, pollenation of the female or fruit-producing palm has been a subject of close study. Natural pollenation has proved unreliable in commercial production and artificial pollenation is practiced exclusively. Both the male and female flowers are borne in large upright clusters enclosed in a spathe, or sheath. This flower cluster is made up of a large number of branches on which the flowers are set. Dates bloom during the period January to April and ripen from August to December 15, although the main harvest season is from September 15 to November 15.

THE common practice of hand pollenation on the larger places is to cut a small branch off the male blossom and place it in the female cluster with flowers turned downward. This is done just before or after the protecting spathe breaks open, and when the male blossom has been put in place a slip string is put over the tip of the blossom. The movement of the blossom cluster on the tree will bring about complete pollenation.

Other growers take the pollen from the male blossom and apply it directly to the female cluster by several different means. Pollen carefully handled may be kept over from one season to another, and many growers always have some on hand should the male bloom be irregular.

Most growers place paper, burlap or cheesecloth protectors over the clusters as they develop size, to protect them from rain and sun. This also prevents a certain amount of bird and animal injury. Damage is often reported from coyotes, mules, and other animals. They also seem to like the desert fruit.

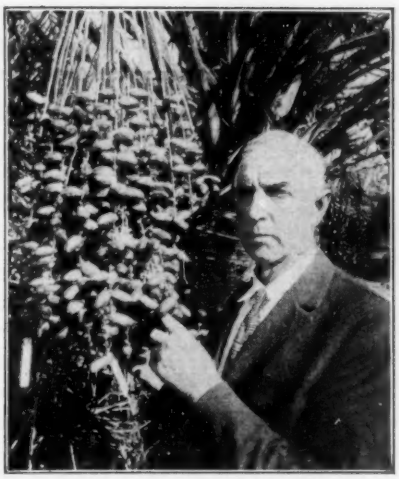
Obviously the picking of dates, especially from the older palms, represents quite a problem. A movable platform on which the pickers work has been devised by some growers. The individual fruits are separated from the cluster threads by a slight twisting motion when they are ripe, or nearly so. The fruit of the firmer varieties is placed in shallow boxes holding about 20 pounds and in these containers transported to the packing house. As not all of the fruit matures

PICKING DATES

An elevated platform is provided for the pickers. Here a Mexican laborer is hard at work plucking the ripe fruit

at the same time, it is necessary to go over the palms every few days, and this individual picking of the fruit is quite expensive. In some instances, a bunch of matured fruit will weigh close to 50 pounds and have from 2000 to 3000 dates attached.

At the receiving end of the packing house, each lot of fruit is weighed in, and a grower's name-ticket placed in every box. The fruit is next loaded on trucks and passed into special fu-



DR. A. D. SHAMBLIN

Dr. Shamblin is the date expert stationed at the government gardens in Indio, California

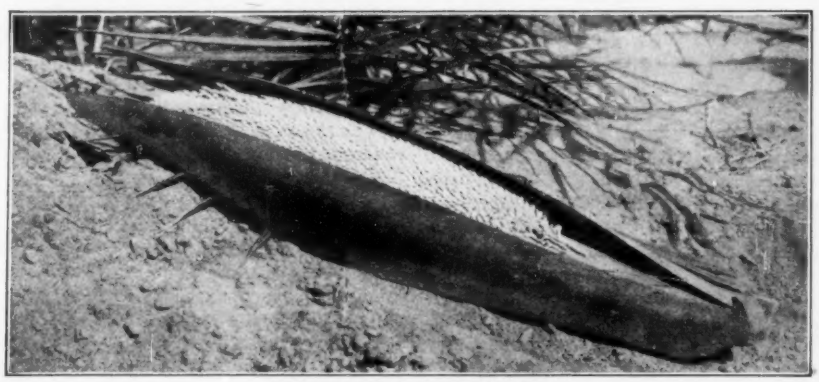
migating tanks, from which the air is then exhausted and carbon bisulfide gas introduced and allowed to remain from one to two hours. The gas is then pumped (being very heavy) or blown out of the tank, which removes the odor from the fruit. Insect life is effectively exterminated by this process.

From the fumigators the boxes of dates go next to the grading room where they are emptied into hoppers and fed through cleaning machines to the sorting tables. Cleaning is accomplished by means of brush and towel devices aided by air suction. Sorting is done by hand from moving belts. The fruit is separated into two or three grades according to quality and a season's pool made of each grade.

FRUIT that is not entirely ripe is spread on shallow, wire-bottomed trays and placed in tight rooms, kept by electric heat at a uniform temperature of 90 to 95 degrees, Fahrenheit, from 24 to 60 hours according to the need. By controlling the moisture content of the air in the rooms, artificial climatic conditions that are favorable to production of quality fruit can be maintained.

Recent experiments in the keeping of dates in cold storage resulted in the erection during the past season of a modern cold storage plant having a capacity of 500,000 pounds of fruit.

The greatest progress in the date industry of California has been made in handling the product for market. Growers realize that the success of their industry depends upon presenting to the American public a product clean and attractively packaged. To this end, growers keep their packing plants scrupulously clean and the progress of the date from the time it is picked until it is placed before the consumer stresses sanitation and freedom from insect infestation.



THE MALE DATE BLOOM

The flower cluster is encased within a spathe or hard protecting cover. The cluster is made up of many branches, of which the individual, pollen-laden blossoms are set in whorls

The Plan Is Theoretically Sound

THE editor makes no apology for publishing the accompanying article. It is not a Jules Verne story nor an H. G. Wells story, nor even one of Dr. Hacksaw's secrets. It is a physicist's conception of a method for getting close enough to Mars to see what Mars is really like. The article was first submitted to several laymen for opinion. They voted against it. It was then sent to several physicists. These favored publication. In itself this may have some significance. Mr. Randolph's plan cannot, of course, be realized at present; he says so himself.

The manuscript was submitted to Professor R. H. Goddard, Department of Physics, Clark University, famous for his experiments on high-speed rockets, with the request for a public statement. Professor Goddard replied as follows:

"According to recent press notices, interplanetary transportation must remain impossible until atomic energy can be obtained and controlled. This attitude is, however, much like that of the scientists of 30 years ago, who declared that an airplane could not operate unless the force of gravity could be neutralized.

"If atomic energy were available, it would be a very convenient means of propelling an interplanetary rocket. Atomic energy is not, however, necessary, as an interplanetary flight is possible with means even now at our disposal. This is set forth in my article in the Smithsonian Miscellaneous Collections, for 1919.

"If a propellant of high energy content, such as hydrogen together with oxygen, is used with high efficiency and in the proper way, an interplanetary flight is possible in a rocket that is neither tremendously bulky nor unwieldy. A rocket using a low energy propellant, and operating inefficiently, would, on the other hand, be impracticably large.

"The technique of such a flight constitutes a most interesting problem in physics, and is one to which I have given considerable thought for many years. In the light of the conclusions I have reached, I can say that, although Mr. James R. Randolph's article, 'Can We Go to Mars,' may read like romance, it is nevertheless thoroughly scientific, and, while not telling the whole story, it gives a good picture of what an interplanetary rocket must be like."

Can

A Physicist's Solution of

THE cave man looked across the river and wondered what was on the other side. Before long he learned to build rafts, and later canoes, so that he could go there and see. The Norsemen looked out upon the broad Atlantic and wondered what lay beyond that gray horizon. Presently they built ships in which they could go there and see.

Thus man has spread himself all over the surface of the earth, and within the past generation he has learned to fly through the air as well. And even the bottom of the ocean is yielding up its secrets.

Today man looks through his telescope at the other members of the solar system and wonders what is there. Will he ever be able to go there and see?

Several of these heavenly bodies might repay at least a passing visit, should such a thing prove possible. The Moon is too airless for anything more, but would be interesting to look at more closely than is now possible. Also its invisible back portion would be worth seeing. Venus and the large outer planets hide themselves behind dense veils of cloud, but there is a possibility that Venus might prove habitable for man.

BUT of them all, Mars presents the most interesting possibilities, and would probably be the first visited. Its skies are generally clear, permitting an easy view of the surface, and this surface appears to resemble our own in some respects, although in others it is very different. There is a possibility that men might be able to live there, although scientists are far from agreement on this question.

And over all this surface is a network of fine dark lines, the "canals" of Mars, which many people believe are the work of beings having intelligence comparable to our own. None of the other theories advanced to explain them have proved satisfactory, at least in the case of certain of these canals. Even a flying visit might settle this question beyond a reasonable doubt, and would show whether or not there really are "people" there.

THE space between the two planets is devoid of air, or any other kind of matter. Hence, there is only one way in which such a trip could be made. A projectile of some sort would have to be thrown off from the earth with sufficient velocity to clear the earth's attraction, and would then have to be directed into an orbit that would touch the orbit of Mars at the time Mars got to that particular part of it. Then, its velocity would have to be reduced so that it could be captured by the planet and become a satellite. Such it would remain for about a year, at the end of which time its speed would have to be increased, returning it to its own orbit, and thence back to the earth.

Thus the projectile would have to be able to change its velocity in a vacuum, and at the start it would have to attain a velocity of seven miles per second, as that is the velocity needed to escape the earth's attraction.

There is only one device known to science at the present time with which these requirements could be met. That is the high-altitude rocket invented by Professor Robert H. Goddard of Clark University. The shells from the largest naval guns have a muzzle velocity of little more than half a mile per second.

The Goddard rocket is now in a stage of development corresponding to the small airplanes built by Langley. Small rockets have been built to test the principle that would be employed in constructing one to reach very high altitudes. The theory has been proved sound, and it has been shown that the problems to be encountered in going from these to large rockets capable of infinite range are no more serious than those involved in the design of huge transatlantic liners. Engineering difficulties may be looked for because of the enormous size of the machine, and the cost will be very great, but the plan is by no means impossible.

STRANGE as it may at first seem, the Goddard rocket, or any rocket, for that matter, works just as well in a vacuum as in the air. In fact it may work even a little better. So the rocket would not have to come up to full speed while in the air, and the changes of speed required after leaving the air entirely behind could readily be made.

This fact has been proved by experiment. It can be readily understood, however, when the principle on which the rocket works is understood. This is the law known as Newton's Third Law of Motion, and states that *to every action there is an equal and opposite reaction.*

For example, if you are standing in an unmoored boat, and walk toward the shore, the boat will drift away from the shore. The air has nothing to do with this. In order to start your body forward you have had to give it a push. This push, acting backward just as much as it does forward, causes the boat to move in the opposite direction.

Again, when the powder explodes in a gun, its pressure drives the bullet forward. But this pressure acts backward on the gun as well as forward on the bullet, and causes the "kick" of the gun. In a rocket there is no bullet, but the gases are expelled downward with high velocity, and the "kick" drives the rocket up at rates of acceleration which could be nicely controlled.

The Goddard rocket differs from the

We Go To Mars?

Approach to a Fascinating Problem, the Which Is, However, Far Away

By JAMES R. RANDOLPH

ordinary rocket, much as a modern turbine differs from a hurdy-gurdy, or flutter wheel. It works on the same principle, but it has been designed for the highest possible efficiency and power output. Some of the latest rockets use liquid fuel whose nature is being kept secret, but the earlier ones used smokeless powder.

In these rockets the powder is confined in a strong steel chamber capable of resisting the pressure of the explosion, and the gases are ejected at the lower end through the expanding nozzle. This nozzle resembles those used in steam turbines, and is designed to give the highest possible velocity to the gas. In some experiments using smokeless powder, this velocity was found to be 8000 feet per second; while more recent tests indicate that velocities as high as 12,000 feet per second can be obtained.

The velocity given to the rocket as the gas shoots out can be calculated by the momentum equation of elementary physics. This shows that a pound of gas coming out at 8000 feet per second would give a 100-pound rocket an increase of velocity of 80 feet per second. ($8000 \times 1 = 80 \times 100$)

The next pound of gas ejected will increase the rocket's velocity by a somewhat greater amount, for the rocket weighs less by the weight of the ejected material; and this process can be kept up indefinitely. Strange as it may seem, the rocket can be made to go a great deal faster than 8000 feet per second, for the momentum equation is not in the least concerned with the absolute velocity of the bodies. It affects only their relative velocity.

BUT as the final velocity of the rocket is increased the amount of powder required goes up enormously. If the final velocity were 3.5 miles per second there would have to be at least 20 pounds of powder for every pound of rocket left at the end of the firing period. If the velocity is to be twice as great, or seven miles per second, the weight of powder will not be twice 20, but will be 20 *squared*, or 400 pounds.

Consequently, these high-altitude rockets are to be made in several sections, so that the chambers carrying the powder charge can be thrown off as fast as they are emptied, retaining only full ones which give the rapidly increasing velocity. Magazine rockets have also been tried, in which the propellant is not put into the pressure vessel until it is to be fired.

Such a rocket could be made in two sections. After the powder charge in the larger rocket has been burned, the casing would be discarded and the smaller rocket would go on alone. This process may be repeated any number of times.

A very large rocket, capable of leaving the earth, and of carrying men, would involve serious engineering problems. The same is true of any structure. A bridge across a small mountain stream is easy to design. One across the Hudson River at New York is very difficult. The same is true of large steamers, large airplanes, and large rockets.

A FEW examples will give an idea of what this difficulty is. A brick pier a few feet high would support a weight of 4000 pounds for each square inch of its surface. But a pier a mile high weighs more than 4000 pounds per square inch of horizontal section. Hence it would break of its own weight, unless spread out like a mountain to give a broader base. Five miles of steel wire form a heavier weight than the wire itself can support. And as these limiting weights are approached, the proportion of structure to useful load increases, and the skill required in design becomes greater, in order to keep this proportion down.

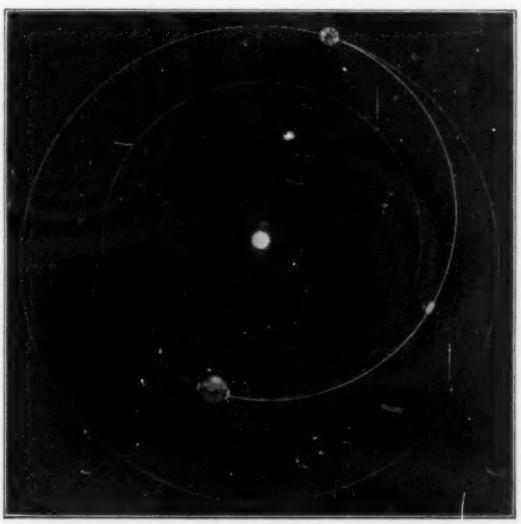
In a rocket, all loads would be greatly increased by the rapid acceleration at the start, but this could be calculated in advance and allowed for. Acceleration in a rocket like this is under perfect control. The numerous small charges are fired by a time clock, and at any rate desired. Even in the simpler rockets, like Goddard's present forms, there are ways of controlling this, as by making the grains of the powder small or large. The smaller the grains the faster the powder burns. But in an actual trip the acceleration should be made just as great as the passengers could stand. This would be tried out beforehand, possibly in a rapidly revolving drum, and the start of the rocket governed accordingly.

A suggested design is shown for the head of a rocket to go to Mars. This gives some idea of the problems that would have to be met in such a structure. Only the top part of the main propelling charge is shown. It is divided among several thousand cylindrical containers, each with a separate nozzle. These are burned in order, beginning at the bottom, and are so proportioned that the charge in each is burned out before there is time for the heat to damage the nozzle. Then the container is dropped, and the one above it comes into play. The walls of the containers awaiting their turn, and hence not under pressure, are counted on to furnish the strength required to support the weight above them.

ABOVE the cabin, and just below it, are shown the powder charges used to slow the rocket down when reaching Mars, for speeding it up to get away again, and for slowing down on reaching Earth. Above and below the cabin are two special jets for making small and controllable changes in the rocket's velocity. The regular containers make changes of definite size.

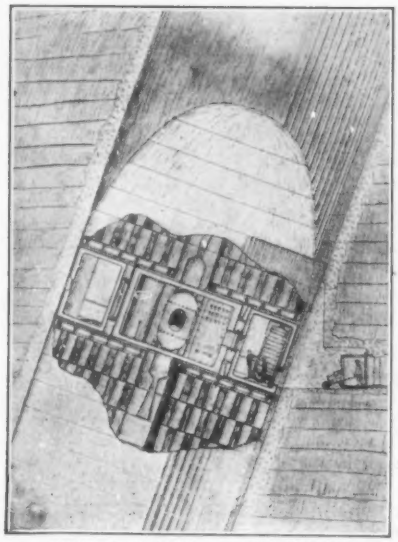
In the cabin structure is a central chamber in which are shown several tanks for the fuel required by these special jets; a pair of gyroscopes to hold the rocket on its course (these are in the spherical ended shell at the center); and at the right the switchboard through which the firing charges are governed.

This chamber is occupied only when starting or changing speed. There would be no people in it during flight.



ORBIT OF EARTH-MARS ROCKET

The earth is shown in position at the start; Mars at time of arrival, seven months later. Round trip, say, two years



MARS ROCKET—AUTHOR'S DESIGN

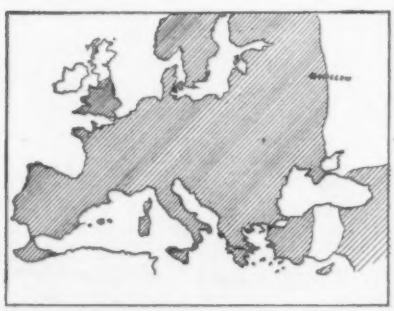
It starts from a shaft in the earth, but by means of its own propellant—no explosion

Around the outside are the passenger quarters, and when in flight these rotate about the central chamber. This creates a centrifugal force that takes the place of gravitation, and holds the people against the outside wall, which then becomes the floor. This provision is essential to the comfort of the passengers. Once the push of the jets had stopped, no action of gravitation would be felt. Man is not adjusted to this condition, and would probably get very seasick. Also, any liquids or small objects that were spilled would float around in the air indefinitely.

THIS rocket, when clear of the Earth, would be given an added velocity of about two miles per second in the direction in which the Earth is moving with a velocity of 18.5 miles per second. This would throw it into a much more elliptical orbit, which would bring it to the orbit of Mars about seven months later. Departure would be so timed that Mars would be there when it arrived. It would then be slowed down until it became a satellite of Mars, which it would remain for about a year. Then, the positions of the planets being suitable, it would be speeded up and brought back to Earth.

A large and heavy mass like this, approaching the Earth at seven miles per second, could not be safely landed. Hence it would be abandoned when near the air, and the occupants would come down in the landing plane, shown on the right near the door. This is a small air tight glider, with folding wings, and having a special door to permit its release.

A rocket such as this would weigh as much as an ocean liner, but would probably be easier to design, as the structure is more compact and the forces more definitely known. But its accommodations would be severely limited, as food, water, and even oxygen for the entire journey of over two years would have to be taken along.



ROCKETS AND WARFARE

Shaded areas are within 300 miles of foreign frontiers, and subject to air raids. Rockets would make this aerial danger worldwide

READY FOR A TEST

Professor Goddard and a small experimental rocket (in the tube which is open at bottom)

Because of its high cost, and the lack of a financial motive for the trip, it is likely to be a long time before such large rockets are built.

The Goddard rocket in its present size could be used for exploring the upper atmosphere, beyond the range of sounding balloons. The next development that is planned is the study of the Heaviside layer, which is supposed to exist at an altitude of about 60 miles above the Earth's surface, and to play an important part in the transmission of radio signals.

It is also planned to take astronomical photographs from outside the Earth's atmosphere.

A further development of the Goddard type of rocket is likely to be that for war. Experiments along this line were begun during the World War, but were dropped when the armistice was signed. At that time they had resulted in a multiple-charge rocket that fired several charges in succession, and traveled straight. It was shown that these rockets could be made at least as accurate as a long range gun, with vastly greater possibilities as to size and range.

Rockets are possible that could shoot half way around the Earth, carrying loads of hundreds of tons—and this offers interesting possibilities for the next war. They could be steered to a limited extent, the pilot staying in the rocket until the last possible moment, and then going off in a landing plane.

Decided changes in world politics would follow the introduction of such a weapon. The armored horseman brought in the feudal system. The gun restored democracy. The modern battleship suppressed piracy, and abolished the rights of small nations. The airplane made the League of Nations a necessity by bringing possible enemies entirely too close for comfort. The rocket would bring America and Russia as close together, in a military sense, as France and Germany now are.

IN the right hands the rocket would bring universal peace. In the wrong hands it would lead to conquest more absolute than anything the world has ever known. The largest empires of past and present could not exist without great numbers of loyal soldiers to hold them together. An empire using rockets would need only governors and spies. The mechanics who made the rockets could be slaves, and a mere handful of men could direct them.

TESTED IN A VACUUM

Rocket is in the straight part. Loop keeps the gases from affecting it. The rocket worked

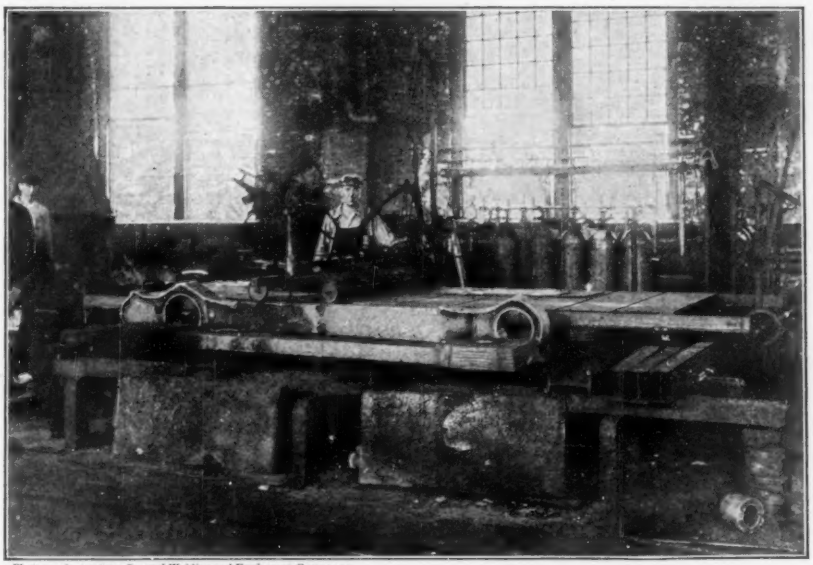
Burning Steel to Form Machine Parts

PRIMITIVE peoples fashioned their dugouts by burning the "core" out of a solid log, thus forming a shell. Today the same principle of burning is being applied to the manufacture of products, not from highly combustible material, but from rolled steel. Huge locomotive main and side rods, large nut blanks, gears, wrenches, and a great variety of other parts are being cut out in this manner.

In this process, which has been developed to a high degree of perfection during the past few years, the part to be burned or, more properly, cut, is preheated to a white heat by a jet flame in which hydrogen, natural or oil gases, or even city gas may be used. A jet of pure oxygen is then played on the metal, causing it to ignite and burn, combustion being nothing more than a rapid form of oxidation. No practical work is done by the preheating flame, however.

High-pressure oxygen, drawn from a tank and expanded to working pressure, cools rapidly so it is necessary in this process also to pre-heat the oxygen. This is sometimes done by the use of hot air, hot water, or steam heating devices. For average cutting, the oxygen may be warmed by passage through the preheating flames at the nozzle.

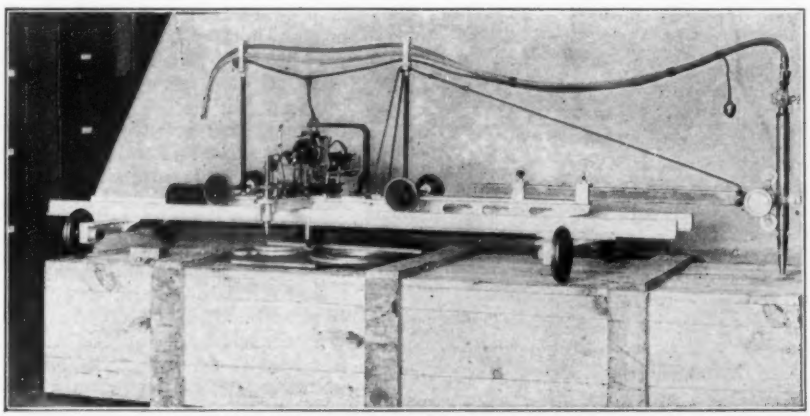
Rolled steel has greater strength and ductility than either cast iron or cast steel, and is much cheaper. In using it to replace such castings, there are the advantages of lower weight which lowers transportation costs, lower cost of metal, higher quality, and less breakage. Add to this the fact that it is necessary to keep in stock only regular rolled material and no great quantity and variety of cast shapes nor great number of costly patterns, and the many other advantages of this process may readily be seen.



Photographs courtesy General Welding and Equipment Company

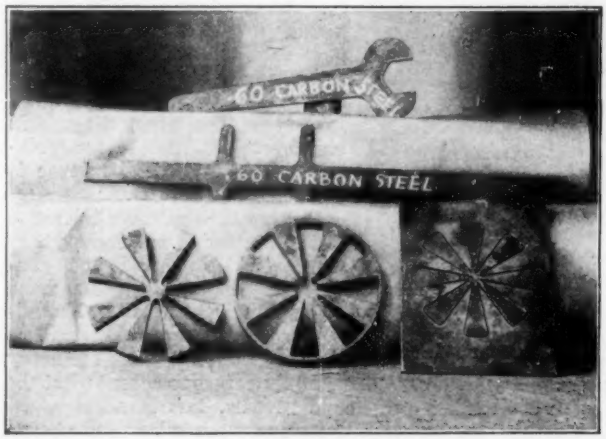
AUTOMATIC SHAPE CUTTING MACHINE FOR RAILROAD SHOP

On this machine a locomotive side rod can be cut in from 15 to 20 minutes. One has just been cut and stands upright to show cut faces. Another billet is laid out beside this ready for cutting



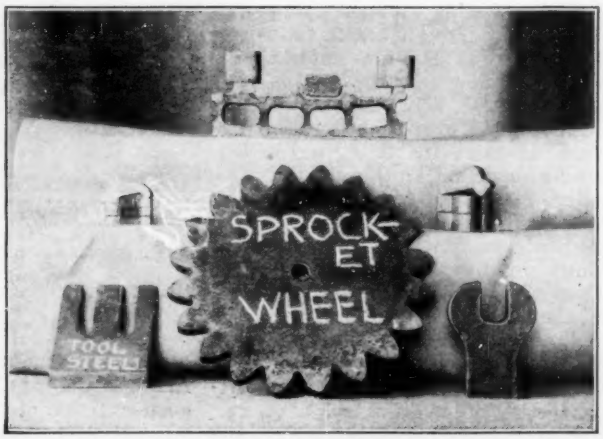
DETAIL OF SHAPE CUTTING MACHINE

The working mechanism of the machine, without bed, showing the double carriage system and the template which governs correct movement of the torch without assistance from the operator



SAMPLE CUTS

Here it will be seen that the edge of oxygen-cut material is almost as clean as if it had been punched, an operation obviously impossible



MORE SAMPLES

In cutting such parts, all the operator has to do is to watch the torch, start and stop the machine which steers itself, and adjust the speed

Three Centuries of Natural Philosophy*

During Many Barren Centuries, Science Crept. Its Recent and Rapid Advances Have Nearly All Pivoted On the Genius of a Few Individuals

By W. F. G. SWANN, D.Sc.
Director, Bartol Research Foundation of The Franklin Institute

THREE thousand years ago there died in Egypt a king. He was buried with much pomp and ceremony, and in the company of such material things as reflected the atmosphere of his time.

After thirty centuries, untouched except for the minor vandalism of robbers, these relics speak to us the story of an age which has passed. They tell us of a skill in craftsmanship equal to our own, of a beauty in art and in concept of design such as wins the admiration of our most famous artists; and reading the evidence of a little act here and a little thought there, we begin to see a people such as we could well have known as friends —a people of whom who can say that if one of them were born today and raised with our children he would be distinguishable from one of us?

YET, neither in the age that knew Tutankhamun, nor in any of the ancient civilizations that have gone before or after, do we find any shadow of a concept of that great scheme of nature's laws which has unfolded itself so unsparingly in our generation.

If the period from the dawn of history to the present time be shrunk into a day, we shall find that twenty-three hours of that day are barren as far as natural philosophy is concerned, for it is only in the last hour that science was born; and, even as the human child develops in its struggles toward manhood, so this child of nature has grown, but with such ever-increasing strength that in the last ten minutes of its existence, in the last twenty-five years of actual time, it has outshone all the accomplishments of its infancy and adolescence and has torn from nature more of her secrets than she has vouchsafed to man in the whole previous history of his existence.

Three hundred years ago we find the world just emerging from the state in which he who would search for the hidden truths of nature must contend with three great obstacles—superstitution, the power of the church, and, last but not least, a conglomeration of fixed notions as to the way things should happen, built upon the pseudo-philosophical reasoning of bygone ages, reasoning founded not upon experimental bases, but upon dogma evolved out of the imaginations of the philosophers.

The train of scientific thought was founded largely upon the hypothesis that the writings of Aristotle were to be the ultimate court of appeal in all matters of dispute, and wondrous indeed were some of the things which Aristotle and his disciples had said. A good example of some of their misty philosophizing is the proof given by one of them that the world is perfect.

NEWTON—BEST INTELLECT

Few would dispute the claim that the profundity of Newton's intellect has never been equalled in any age

"The bodies of which the world is composed are solids, and therefore have three dimensions. Now three is the most perfect number; for, of one we do not speak as a number, of two we say both; but three is the first number of which we say all. Moreover, it has a beginning, a middle, and an end."

Towards the end of the fifteenth century we find young Galileo enjoying the princely stipend of fifteen cents a day as professor of mathematics at the University of Pisa. It is true that the professor of medicine gets thirty times as much, and Galileo's parents had originally intended him to be a professor of medicine. But what does he care! For he is much interested in discovering the laws of falling bodies; and, in spite of the fact that Aristotle has said otherwise, he is contending that heavy bodies and light bodies fall at the same rate. In scientific circles much resentment is felt at such a revolutionary suggestion; for Aristotle, without appeal to experiment, has evolved out of the consciousnes of his inner mind the decision that bodies fall at rates depending upon their weights.

IT matters not that young Galileo has ascended the leaning tower of Pisa with a one-pound weight and a hundred-pound weight and, in full view of the learned men of the day, has dropped them from the tower and found that they struck the ground together. For Aristotle has maintained otherwise, and science is the voice of Aristotle.

Neither is there more tolerance in the matter of astronomy. For Galileo has invented and constructed a telescope; and although he has received much honor from his university for this performance, and has had his salary doubled, there are many who not only refuse to accept what the telescope reveals, but steadfastly refuse to look through it lest they should be convinced of the truth of that which they do not wish to believe. With this

*Founders' Day Address, Swarthmore College. From *Journal of The Franklin Institute*

obnoxious machine Galileo has found that the moon has mountains like the earth, which robs that body of some of its individual importance. He has found spots upon that most perfect of heavenly bodies, the sun, but worst of all he says that Jupiter has four moons attendant upon him. This last conclusion is in a way to upset everything.

Although too much of a man of progress to doubt the evidence of his own eyes, even the great Kepler is disturbed in his mind. For, according to all prevailing notions of the day, there should be seven planetary bodies and no more—the earth, moon, Mercury, Venus, Mars, Jupiter and Saturn.

Hear the argument of Francesco Sizzi, himself a Florentine astronomer, against this assertion of Galileo:[1]

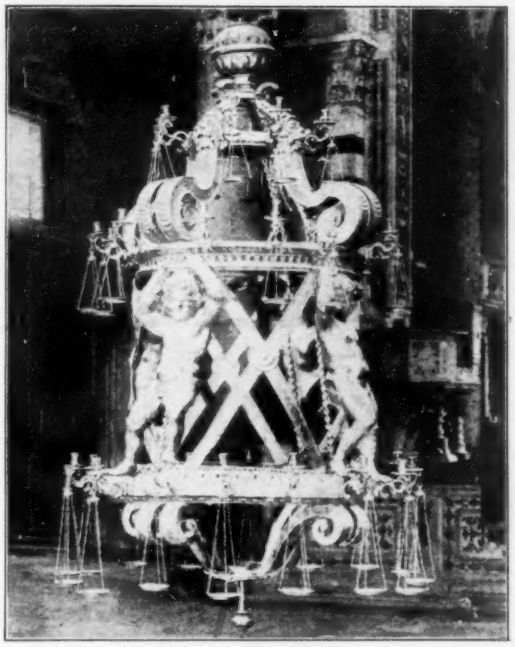
"THERE are seven windows in the head, two nostrils, two eyes, two ears, and a mouth; so, in the heavens there are two favorable stars, two unpropitious, two luminaries, and Mercury alone undecided and indifferent. From which, and many other similar phenomena of nature, such as the seven metals, etc., which it were tedious to enumerate, we gather that the number of planets is necessarily seven.

"Moreover, the satellites are invisible to the naked eye, and therefore can have no influence on the earth, and therefore are useless, and therefore do not exist.

"Besides, the Jews and other ancient nations as well as modern Europeans have adopted the division of the week into seven days, and have named them from the seven planets; now if we increase the number of planets this whole system falls to the ground."

You can judge of the wrath and indignation which Galileo brought upon his head when he contended in reply that, whatever might be the force of these arguments as a reason for believing beforehand that no more than seven planets would be discovered, they hardly seemed of sufficient weight to destroy the new ones when seen.

It was Galileo who wrested from nature the secret of the laws which govern motion—the laws which govern the motions of almost everything, the planets in the heavens, the fly wheel of the steam engine, the bird in flight—yes, and in a large measure at any rate, the motions of the innermost parts of the very atoms of matter itself. But Galileo did not evolve these laws out of the dogmas of imagination, but by the more humble and safe appeal to direct experiment. He marked out the method of approach, the experimental method, which has been the model for all succeeding generations in their search for the fundamental facts which govern the workings of nature.



FAMOUS SWINGING LAMP

Was it a dull sermon that diverted the youthful Galileo to the epochal discovery of the laws of the pendulum?

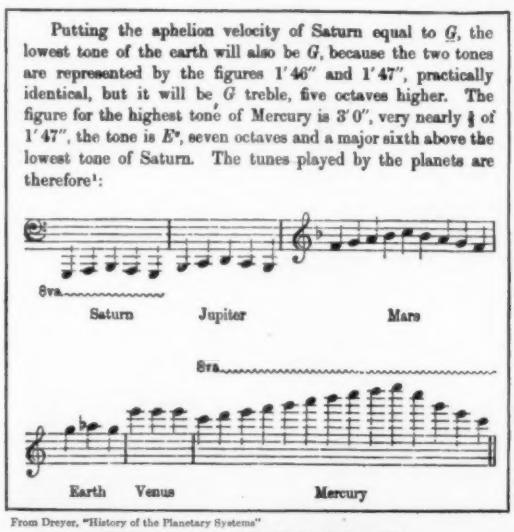
THE laws of motion may be written on a postcard, but their consequences have not been exhausted in all the books men of science have written in three hundred years. As we all know, Galileo's life was beset with tribulation. He lived in an age when there was little tolerance for one who followed not the conventionalities of thought of the day. To question the learning of the past was arrogance, to discover new truth was blasphemy, and so he died having sown, however, the seeds of the fruit that was to come. He died in a world seething with superstition and ruled by the dogmas of an ancient past, but a world which was destined only a year later to see the birth of one who is rated by many as the greatest genius of all time—that great prince of England's men of science—Isaac Newton.

In its purest aspect, the task of the natural philosopher to-day is to discover the relationships existing between the different phenomena which happen in our universe. He seeks to see in the workings of nature simply different illustrations of a few fundamental principles. Newton was the greatest of the pioneers in this method of systematized thought. In his great work, the "Principia," characterized by the Marquis Laplace as pre-eminent above all productions of the human intellect, he demonstrated the powerful simplicity of the fundamentals which control the destinies of the heavens. No longer did the universe appear as a bizarre and formless thing governed by such a heterogeneous system of agencies as to merit well the caustic comment of the sovereign of Castille when, bewailing the complexities involved in an attempt to explain the motions of the planets, he remarked that "Were the heavens thus constituted, he could have given the Diety good advice."

No longer need the sun carry spokes, as Kepler thought, to grind the planets around in the heavens. No longer was a guardian angel necessary for each planet to guide its course. No longer were the planets whirled through space by the whirlpools of an ether as a twig is whirled about in the rapids.

ALL that was necessary was the laws of motion of Galileo, operating under the influence of a force emanating from the sun according to the inverse square of the distance therefrom. And this force was no new and mysterious thing, for Newton showed that gravitation, that same old force which had been known for so long—gravitation which causes apples to fall from the tree to the ground—was sufficient to control the moon in its orbit, and such a gravitation with its origin in the sun served the purpose of controlling the planetary motions. Moreover, in this same gravitation did the tides find their origin through an

[1]Quoted from Sir Oliver Lodge's "Pioneers of Science."


Putting the aphelion velocity of Saturn equal to G, the lowest tone of the earth will also be G, because the two tones are represented by the figures 1'46" and 1'47", practically identical, but it will be G treble, five octaves higher. The figure for the highest tone of Mercury is 3'0", very nearly ⅔ of 1'47", the tone is E♭, seven octaves and a major sixth above the lowest tone of Saturn. The tunes played by the planets are therefore[1]:
8va
Saturn
Jupiter
Mars
8va
Earth
Venus
Mercury

From Dreyer, "History of the Planetary Systems"

THE MUSIC OF THE SPHERES

Early science was burdened with much nonsense of this kind. It has not all departed from the world, even yet

GALILEO IMPRISONED

Galileo was not notably tactful, but the stubborn dogmatic ignorance of his age must have been maddening to him

attraction of the moon. In this same gravitation from the sun, combined with the flattened shape of the earth, did that mysterious conical motion of the earth's axis concerned with the precession of the equinoxes find its origin, and in the laws of Galileo was to be found an explanation of the actual flattening of the earth's shapes as a result of the centrifugal force of its rotation.

These and many other things did Newton demonstrate in the "Principia" and by their means brought astronomy from a state of pure charlatanism to the state of order symbolized by Pope's famous words, "Nature and Nature's laws lay hid in night, God said: 'Let Newton be' and all was light."

EVEN as our greatest architects strive for beauty couched in a fundamental simplicity of design, so the Grand Architect of the universe revealed himself in Newton's great work as the father of the principle of dignity of structure through ultimate simplicity. It is a great faith in the possibility of seeing in the operations of nature the working of principles which are ultimately simple which, as each new discovery is revealed, has encouraged man to the hope that he may some day understand them.

While to-day nature has revealed many treasures unknown to Newton, there are few who, realizing the great stride made in the "Principia," will not to-day join with Halley in his eulogy of that great work, "So near the gods man cannot nearer go."

When an outstanding genius causes science to take a leap forward beyond the vision of his contemporaries, there usually follows a period of depression in which it seems that all that is worth doing has been done, and that what the universe has not already revealed must forever defy the power of man to fathom. Such a period followed Newton. Of course, much valuable work was done in the years which came after, but it took more the form of a development of the consequences of Newton's labors than of the discovery of new paths of knowledge. And then, only about a century ago, a new page in the architectural designs of the universe was turned, and the heading on that page was *electricity*.

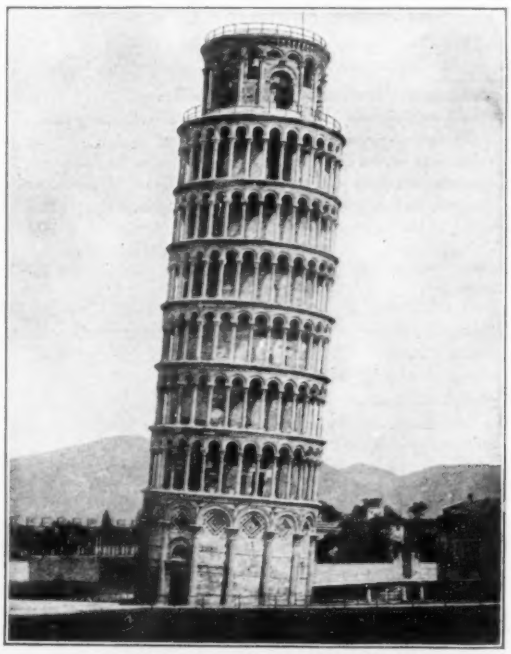
The forerunners in the march of science do not often come heralded by much ceremony suggestive of the power that lies behind them. Often in apparent trivialities do they reveal themselves — trivialities so void of spectacular content that but few can be found who deem it worth while to listen to their story.

A HUNDRED and fifty years ago little more was known of the science of electricity than the fact that if a black rod is rubbed with the skin of a cat it will acquire the power to pick up small pieces of paper, and, if viewed in the dark, will be found to emit a blue glow. One can hardly imagine a set of phenomena more vulnerable to the scoffer; for, black rods and cats have been the stock paraphernalia of witches from time immemorial—the blue light visible in the dark adds no particular prestige to the phenomena. And then, we find that these things will not reveal themselves in the presence of water. Now, we should say that water destroys the electrical insulation, but the scoffer who had heard so much of the fundamentality of that triumvirate, "earth, fire and water," might find ample wherewithal to whet his sarcasm, and even though he should admit the reality of the phenomena themselves, he might well attack them on the basis of their futility, for it would appear that if all the black rods in the world were rubbed with the skins of all the cats, the most that might hope to be accomplished would seem to be the raising of a small weight of totally insignificant amount. And yet, on this earth at that very time there existed, and within the reach of man, the wherewithal to make a dynamo.

To one who contemplates the enormous manifestations of electrical power today, it seems almost inconceivable that all of these potentialities could have remained dormant for the whole period of man's civilization.

The Royal Institution of Great Britain was founded by Count Rumford in 1799. Its stated purpose is "the promotion, diffusion, and extension of Science, and of useful knowledge." To its lectures given by Sir Humphry Davy at the beginning of the last century came a young bookbinder's apprentice, whose enthusiasm sufficiently impressed the lecturer to result in his being appointed as assistant at the Institition.

UNFORTUNATELY, it became necessary for the young man to have some money wherewith to live, but there was no money for scientific assistants. However, the Institution had an appropriation for janitors and so the bookbinder's apprentice, Michael Faraday, became janitor at the Royal Institution. I do not know how efficiently he performed his duties in the office of janitor, but even though he may have neglected the windows of the laboratory, he cleaned well the windows of science, and even though he may have neglected the cobwebs on the walls of the building, he cleaned many of them from the horizon of knowledge.



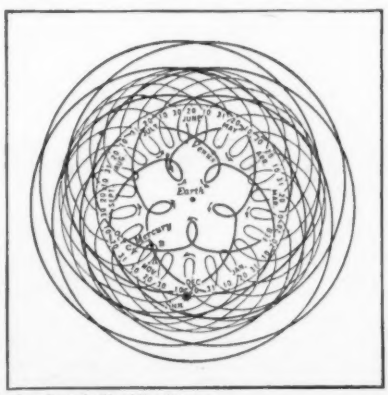
GALILEO'S REAL MONUMENT

Here he demonstrated the action of falling bodies. Observers consulted their Aristotle, and "proved" Galileo's "error!"

The fact that wires carrying currents possessed in many respects the characteristics of magnets was already known, but it fell to Faraday to discover the fact that batteries were not the only means by which electric current could be produced, and to demonstrate the fundamental principles upon which electrical engineering is based today. By the labors of that little group of men, Ampère in France, Faraday in England and Henry in this country, we came into possession of most of the facts governing the broader features of electrical science, of the facts which tell us how to build a dynamo, a motor, and the like. We came to know of strange new forces with mysterious relations between them. But what was their explanation—what was the secret of their mutual relations—of what broad principles of the design of the universe did they form a part? Then came Clerk-Maxwell who sought to correlate these discoveries into a harmonious unity.

MAXWELL was a great mathematician; and, as a result of his labors, he wrote a book which few could read, but which, in the years that have followed, has served to mould our thoughts to that comprehension of the subject which we enjoy today.

The place of the mathematician, of the dreamer, in natural philosophy, is not always apparent to the layman. He takes the facts which the experimenter gives him, and seeks to correlate them as part of a greater framework of truth in the hope that the frame itself shall suggest other things which may be true, and thus stimulate further search, and widen our comprehension of the whole. A man coming to us from another country, or from another world might, by observing the actions of our President, our Secretary of Labor and the governor of one of our states, form some sort of an opinion as to the probable actions of these individuals under given circumstances. His understanding of the whole situation would, however, be much less complete than

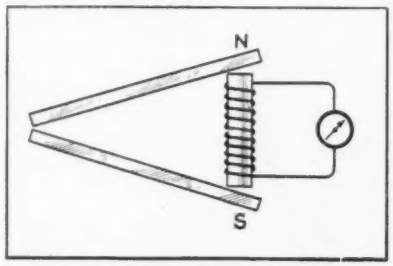


From Proctor's *Old and New Astronomy*

THE INNER PLANETS

At all costs the earth must be retained as the hub of the universe! Hence this maze

it would be were he acquainted with the whole mechanism of our constitution, or even with some part of it which was fairly complete in itself. If his knowledge is confined within the limits we have supposed, however, he might take such information as he had, and try to reduce it to some sort of order by building in his mind a constitution of which such individuals as he knew

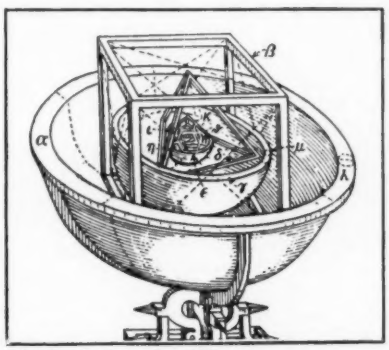


FARADAY'S EXPERIMENT

When the coil was moved between the magnets, a current flowed—the first dynamo!

formed a part. In this creation of his mind, he would have to picture many new individuals and offices in order to complete the framework of his thought. He would naturally suggest a search for these individuals. Every additional one found would add more certainty to his general plan, while every one he failed to find would give him a clue as to how his plan should be modified in order to conform to the facts.

When all was complete, or, indeed, long before all was complete, long before he knew the status of every minor clerk in the government's employ, he would be conscious of a much better understanding of the whole situation,

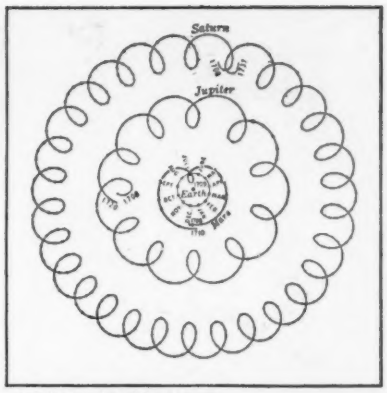


From Duncan's *Astronomy*, by permission

AS KEPLER SAW IT

By spheres, cubes, tetrahedrons and dodecahedrons, he explained the orbits of the planets

and would be in a much better position to draw upon the services of the government than he was when the whole of his knowledge was confined to the actions of the three individuals we named at the start. If this man, who corresponds to our mathematical physicist, should now go back to his own people he would doubtless have much difficulty in making them understand the plan of our government. The facts they would have to accept, but it might



From Proctor's *Old and New Astronomy*

PTOLEMAIC SYSTEM

How the biblical school of astronomers accounted for the motions of the outside planets

be only after prolonged experience of our actions that the mechanism of our procedure would enter into their inner consciousness with that force which implies understanding.

So, Maxwell sought and found a beautiful scheme of thought in which to comprehend and harmonize the discoveries of his predecessors. The form of his scheme was such as to suggest that it should be possible to propagate electromagnetic disturbances in the form of waves in an all-pervading medium, and that certain of these waves should have the properties of light waves, and that all should travel with a velocity equal to that of light.

HIS conclusions in the latter respects were beautifully verified by his calculation of the correct velocity of light from purely electrical data, and his predictions in the former have received wonderful justification, first in the experimental work of Hertz and Lodge, and finally in the modern developments of wireless telegraphy and telephony in the hands of Marconi and others, developments which at every stage of their progress have drawn upon the principles outlined in Maxwell's great work. We now know that the electromagnetic waves of wireless, heat rays, light rays, the ultraviolet rays used therapeutically, X rays, the gamma rays emitted by radium and the cosmic rays of which we have heard so much recently, are all special cases of electromagnetic waves differing from each other in their essentials only as regards their length. The longest are the wireless waves, which attain lengths of the order of a mile, and the shortest constitute the cosmic rays, whose length is comparable with the millionth of a millionth of a centimeter.

And then, following Maxwell, once again science made one of those pauses for breath in which many seem to see the end of all that man may hope to know—those dread pauses in which the horizon of discovery seems the boundary thereof. (*Concluded next month.*)

All Photographs Courtesy Metals Protection Company

TREATMENT TANKS, NICKEL AND CHROMIUM PLATING BATHS

The hoist crane lowers the work into the treatment tank in the rear, then brings it forward through cleaning, nickel plating, treatment, and cleaning tanks to the chromium plating tank in front

Enter Chromium Plating

Process Is Successful After Years of Study and Perfection of New Treatment

THAT pocket lighter you bought some time ago—perhaps you have wondered what metal was used to plate it and give it its beautiful silvery surface. You realized that if platinum had been used, it would have been so marked; and the surface was harder and more lustrous than nickel. More than likely it was plated with chromium, for many pocket-lighter manufacturers, as well as manufacturers of other plated products, have taken advantage of the superiority of this metal over other plating metals and have adopted it as a finish for their products.

Within recent years, great strides have been made in the perfection of the chromium plating process. Almost 75 years have elapsed since Bunsen first obtained metallic chromium by electrolysis of chromic acid, but it is only since the World War that the conditions necessary for obtaining a satisfactory commercial coating of the metal have been worked out. The process is one requiring far more study, experimentation, and research than that of commercial plating with any other metal now generally used.

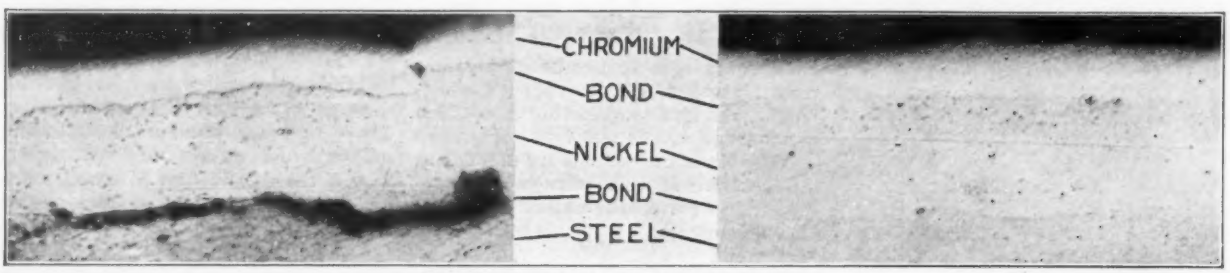
An electroplating bath for chromium known as the "acid" bath, was worked out by Carveth and Curry in 1905; a "neutral" bath was worked out in 1920 by Sargent, this being essentially the same as that generally used at the present time; and the "basic" bath was developed from Sargent's "neutral" bath by the addition of a small amount of chromium chromate. These three baths are identical, not only in behavior, but in ultimate composition. Technological Paper Number 346 of the United States Bureau of Standards concludes that "the recent industrial success of chromium plating must, therefore, be attributed not to any improvement which has been made in the bath, but to its more careful operation and control."

Metallic chromium ranks next to the diamond in hardness and it is many times harder than the best steel. It possesses high resistance to corrosive and tarnishing influences such as all alkalies, oxygen, chlorine up to 300 degrees Centigrade, sulfur, superheated steam, and concentrated nitric and sulfuric acids. It is too brittle to be used alone, but alloyed with steel, it has become familiar to everyone in stainless steel cutlery. These qualities, together with its platinum-like finish and high polish, make it a valuable plating metal.

IT is now being applied to such widely different articles as plumbing fixtures; watch cases; automobile bumpers, trim, et cetera; surgical instruments; and machine spindles and parts where wear is excessive. The United States Bureau of Engraving and Printing found that by chromium plating the intaglio plates used for engraving notes and securities, they could be made to last indefinitely, thereby saving thousands of dollars yearly. Formerly these plates had been coated with nickel, but the cloth used to wipe them soon wore away the surface so that they had to be replaced. With a coating of 0.0002 of an inch of chromium, the plates give a better impression and last much longer than nickel or face-hardened ones. When the chromium does finally wear slightly, the plates are stripped with hydrochloric acid and again chromium plated.

Chromium has been successfully plated on most of the common metals except aluminum. In the case of iron and steel, however, the danger of cracking of the plated surface makes desirable a coating of copper or nickel, or both, before the chromium is applied.

In chromium plating, the article to be plated is the cathode, while the anodes most commonly used are of the



CROSS-SECTIONS OF PLATED PIECES

Comparison of adherence, under a 1000-power microscope, of untreated and treated base metal, shown at the left and at the right respectively, plated first with 0.002 of an inch of nickel and then with 0.0002 of an inch of chromium. The base metal was cold-rolled steel

insoluble type, lead being generally used. Metallic chromium, although readily soluble in acid baths, has not been used for anodes probably because pure chromium has been decidedly less expensive in the form of chromic acid or, strictly speaking, chromium trioxide. The chromium content of the bath is maintained by periodic additions of chromic acid. Steel, crockery, or lead-lined tanks are used as receptacles.

DURING the plating operation, a large amount of hydrogen is evolved at the cathode and oxygen at the anode. These two cause a fine acid spray which destroys the tissues of the respiratory tract. For this reason, ventilating hoods are sometimes used but these must not cause too close confinement of the explosive mixture of hydrogen and oxygen. Most often a sheet metal duct having a slot in the side facing the liquid, surrounds the top of the tank. When air is drawn through this duct at high velocity, a "suction blanket" is created over the surface of the liquid, effectively removing all fumes.

The character of the deposit may vary between wide limits according to the conditions of the operation and the control exercised, the kind of surface to be plated—the metal, its finish, and the kind of cleaning process through which it has passed—the composition and temperature of the bath, and, of course, the current-time.

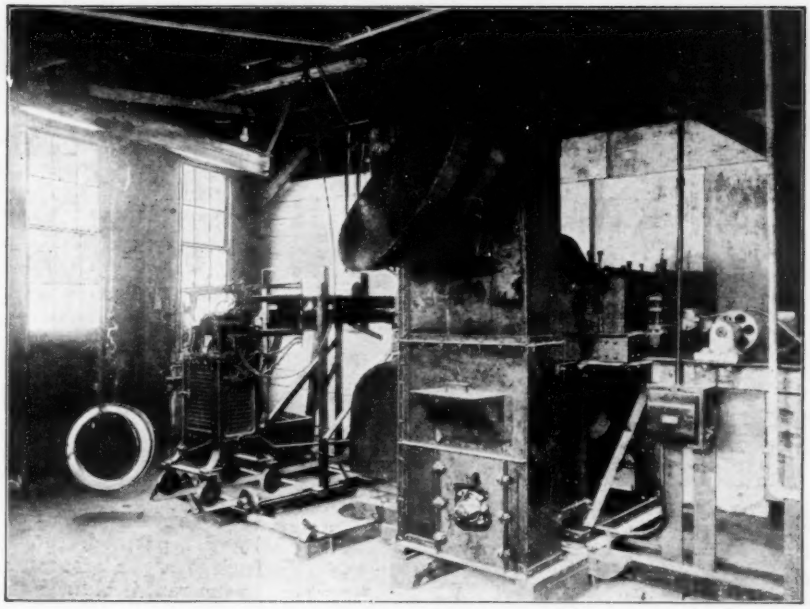
In most cases, each article to be plated presents an entirely new problem. The exceedingly poor "throwing power" of the chromic acid bath and the consequent difficulty of obtaining a uniform thickness of deposited metal on an irregular piece presents perhaps the greatest. This is usually overcome by arranging the racks and building the anodes to conform to the shape of irregular articles so that the current density over the whole cathode will be as uniform as possible.

Care must be exercised in chromium plating in so many ways that we could not begin even to outline them here. The degasification treatment, however, deserves special mention, since it marks a big step in the perfection of the process. This process consists of the removal from the surface of the metal, prior to plating, of the occluded and adsorbed gas which, if allowed to remain, will frequently cause cracking and scaling of the plated metal.

A number of attempts to degasify metals have been made, but the one now receiving the most attention in this country is that developed by Mr. Charles P. Madsen. In this process, the metal is made the anode for a short time in a bath of 66 degree Baumé sulfuric acid at ordinary temperature. The voltage may be varied from six to 24 volts, alternating or direct current, and the current density from 25 to 50 amperes per square foot. This is not, strictly speaking, an electrolytic cell nor is the sulfuric acid an electrolyte. Neither is it a pickling bath since it removes deeply-imbedded foreign materials resulting from rolling mill operations, and other matter not ordinarily removed by pickling but which interferes with good plating and prevents close adherence.

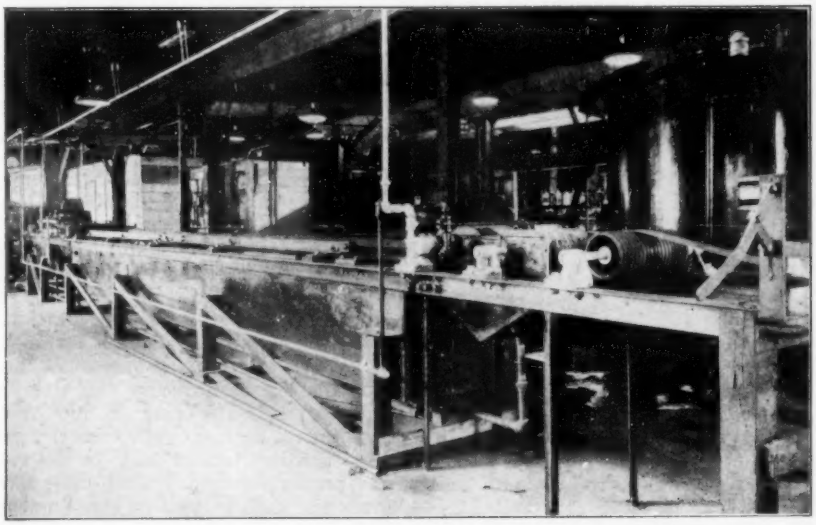
IT is said that all common metals, except aluminum, may be successfully degasified in a few minutes and that under proper operating conditions, the bath produces an extremely fine etching of the metal surface. This affords innumerable opportunities for the crystals of the plating metal to interlock firmly with the surface crystals of the base metal. Subsequent coatings of nickel, chromium, or other metal on the treated steel or other sheet, adhere closely in a film that is in the nature of an alloy between the base and the coating metal. Repetition of the treatment on the first coating gives good adherence for the second plating metal.

Chromium-plated sheets, bars, plates, et cetera, that have been treated in this manner may be bent, pressed, fabricated, or punched easily without flaking of the surface.



DEGASIFICATION OF METAL STRIP

Strips for the manufacture, after plating, of tubes or pipes, are run through this machine which degasifies and cleans them. From this point, they pass over rollers into plating bath at the right



STRIP PLATING

From the degasification machine at the extreme left, the strip is drawn through this nickel plating bath, over the rollers at the right, and through a similar tank for the final chromium plating

Sun Dials *and* Sun Dialling

There Are Sun Dials of Many Types to Suit the Purse and Skill of Every Amateur Who Enjoys the Pursuit of a Scientific Hobby

By RUSSELL W. PORTER
Optical Associate, Jones and Lamson Machine Company
Corresponding Editor, SCIENTIFIC AMERICAN

MR. HARTNESS AND HIS DIALS

Figure 1: *Former Governor Hartness of Vermont, well known inventor of machine tools, is also an amateur astronomer. He invented the enclosed turret telescope*

THE usefulness of the sun dial has long since departed, along with the tallow dip, the ox cart, and the spinning wheel. Nothing is left but the romance and sentiment, and the wealth of solemn mottoes warning us that time is fleeting, and that

"As time and hours do pass away
So doth the life of man decay."

Except as a picturesque reminder of the past in the corner of some old rose garden, a dial has no part in our lives. When we can obtain the time over the radio accurate to a second's fraction any day or night; when we can carry it constantly in our vest pockets, why give this relic of the past a moment's thought?

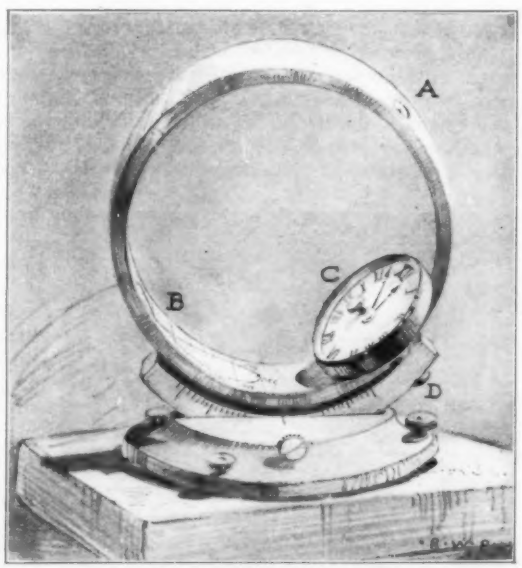
THE present generation little realizes that until the invention of clocks and watches, sun dials were the only time keepers available, and that schools taught the art of dialling as an important study.

It is said that the first record of a sun dial is given in 2 Kings, XX, 9-11, where a miracle was performed by the Lord who made the sun's shadow move *backwards* some 10 degrees. This phenomenon has afforded a fruitful source of mathematical demonstration to prove the miracle possible—or impossible. One ingenious dial maker seems to have actually caused the sun's shadow to move backwards on the dial face, by making the face cup shaped and filling it with water. Refraction does the work.

Even were we dependent on sun dials today for our time, their accuracy would be of so low an order that they would be of little value. I do not suppose the average sun dial can be depended on to within a few minutes, for the edge of the shadow cast by the gnomon, coming from so large a light source as the sun, is blurred and ill defined and therefore cannot be read with precision.

Now our civil time is really artificial, in that it makes the days all of equal length. Since our watches must run at a uniform rate they will not indicate sun time, because the sun appears to move faster at some times than at others. So we have created a fictitious sun that crosses our meridian promptly at 12 o'clock each day. The real sun is often ahead of, sometimes lagging behind, this fictitious sun and the difference between the times of these two suns (between the sun dial and a watch) is a variable interval amounting at times to as much as 16 minutes—known among astronomers as the "time equation."

And so, when clocks came into vogue they kept a different time from the sun dials and there arose the necessity of adding or subtracting this equation from the shadow readings of the dial, in order to give clock time. Many very ingenious devices have been applied to sun dials to accomplish this correction automatically without the need of tables and the necessary calculation. For, what one wants nowadays is to be able to step up to his sun dial and read off his watch time at once. The Hartness dial shown in Figure 1 is a good example of this class. Here a carefully formed cam, after being set to the day of the month, has moved the graduated hour circle about the gnomon just enough so that civil time may be read off directly. Even an allowance for leap year complications is provided for.



AN AUSTRALIAN INVENTION

Figure 2: *This unusual sun dial gives the time on a common clock face, just as if it were an ordinary clock*

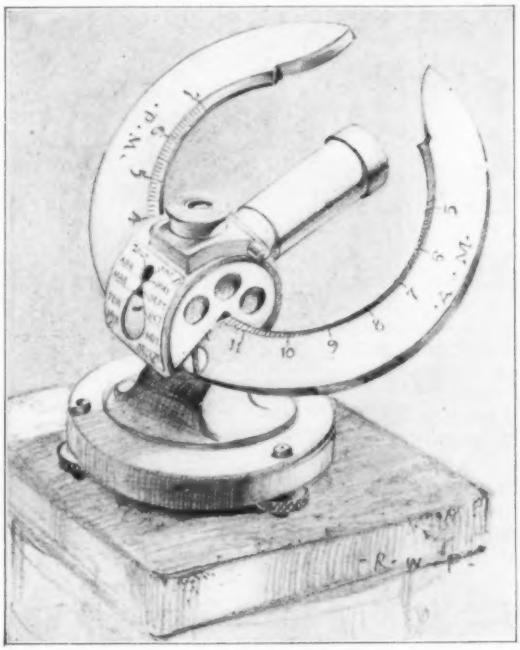
A STRIKING advance in dialling has been made by the Government Astronomer of New South Wales, Mr. W. E. Cooke. This is shown in modified form in Figure 2. Its distinctive feature is that it permits one to read standard time directly from the face of a clock. This "clock" contains no springs or movement, but consists simply of a shell and the ordinary clock face and hands. When the large ring of the dial is turned so that the sunlight passing through hole *A* falls on the analemma on the opposite side of the ring, the hands of the clock, which are connected to the ring by means of a train of gears, are moved to the correct position. The case of the clock is fastened by a stud to the base at *D* and does not move as the ring is turned. The ring is mounted on a segment of a circle, so that the instrument may be set to the proper latitude. This dial also gives the date as well as the time of day.

Sun dials are of several types—horizontal, vertical, cylindrical, and

so on. In the familiar horizontal form the gnomon which casts the shadow is parallel to the earth's axis and points to the north pole of the heavens (in the northern hemisphere).

ALSO the dial face must be truly level. Should any one desire to make a sun dial for himself, full and elaborate instructions will be found in the "Encyclopedia Brittanica" under "Dial and Dialling," while simpler rules are given in that delightful book, "Sun Dials and Roses of Yesterday" by Alice Morse Earle.

My own interest in sun dials has been aroused in the hope that in some way, perhaps by the aid of lenses, the time can be read to an accuracy of seconds instead of minutes. It has seemed to me that if an image of the sun itself could be cast on the hour circle, definition of the sun's edge would allow much closer reading.



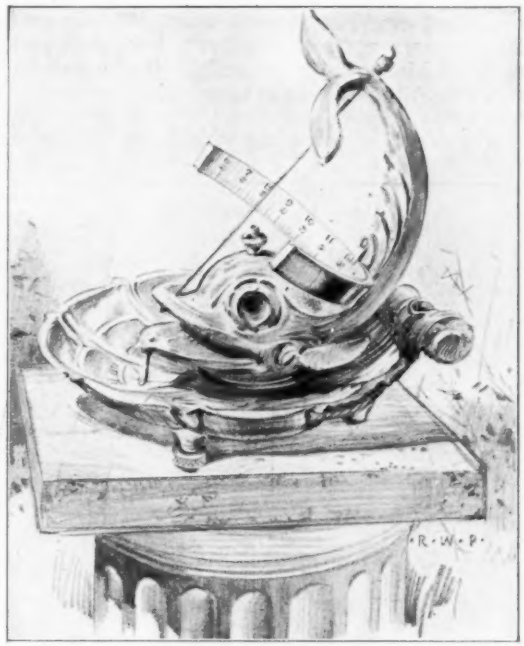
STILL ANOTHER TYPE

Figure 4: *This one is read by means of an eyepiece and will give accurate time when the adjustments are all made correctly*

However my first adventure in dialling was more in the nature of a garden accessory (Figure 3). It might be called the dolphin sun dial and bird bath, in which the gnomon is a wire stretched between the animal's nose and tail. Also incorporated in this dial was the idea of leveling it up with water in the shell as a reference plane, thus making it independent of any leveling bubbles. The dolphin has a spherical seat and can be tilted until the proper latitude (marked on his tail) coincides with the water surface when the wire is brought parallel to the earth's axis. The equation of time is provided for by shifting the hour ring on the dolphin's back.

Two dials were made, using lenses and prisms. The first is shown in Figure 4. This one somewhat resembles a surveyor's transit tipped over until its horizontal plate is parallel with the plane of the earth's equator. Here, however, the telescope is lowered so that the sun's image is projected directly on the hour circle and read by means of the eye piece. At the same time the telescope is shifted laterally by setting on the analemma, thus compensating for the equation of time.

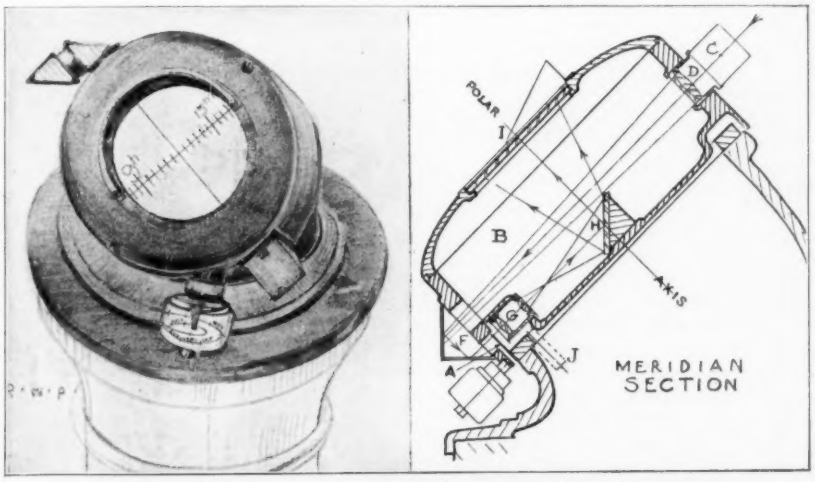
The other dial is shown in Figure 5. This was more complicated, and to understand its operation the reader must consult the section shown in the same figure, in order to follow out the path of the sun's rays. The fixed hour circle is shown at *A* and is graduated on transparent celluloid. Around this circle is rotated the box *B* carrying the following optical train: prisms *C*, lens *D*, prism *F*, eyepiece *G*, mirror *H*, and ground glass screen *I*. What happens is this: The cover is turned until the sunlight passing through the lens forms an image of the sun on the transparent hour circle. The eyepiece then magnifies both this image and the adjacent graduations on the circle, projecting them upon the ground glass. The observer thus sees a picture of the sun about a half an inch in diameter, crossed by the graduations of the hour circle. The time equation is applied by rocking the dial box about the pivot *T* by means of a cam, as in the Hartness dial.



THE DOLPHIN DIAL

Figure 3: *The dolphin carries the gnomon between his nose and tail. The dial is adjustable to the user's latitude*

IT would be quite impossible to juggle with so many lenses, prisms and mirrors with anything less intense than sunlight. But there is such an abundance of sunlight that even a half-inch lens gives a brilliant image on the screen, and the last of these dials gave very

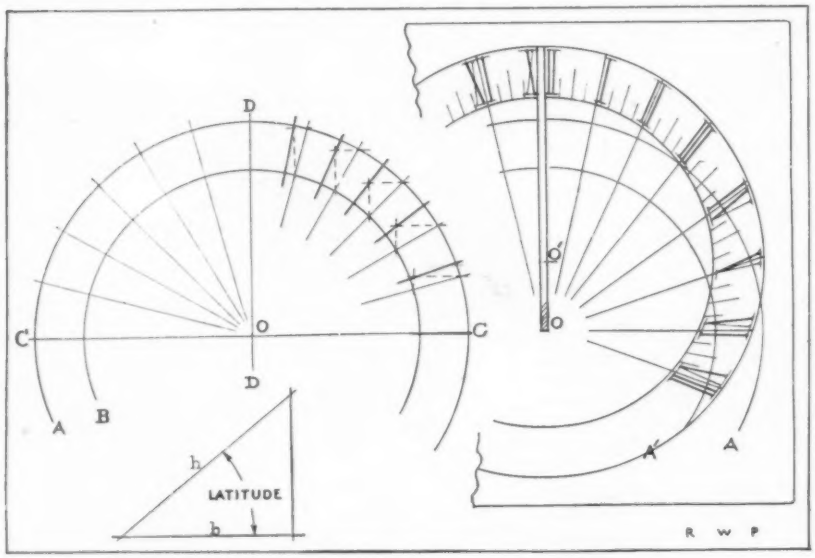


RATHER COMPLICATED, BUT CORRESPONDINGLY PRECISE

Figure 5: *The dial is shown on the left, the drawing on the right being a cross-section of it, permitting the reader to trace out the optical train. Precise readings may be obtained from it*

consistent readings through most of last summer until a neighbor's boy satisfied his curiosity by pulling the instrument to pieces so as to see what was inside.

The easiest way for one wishing to make his own sun dial of the conventional, horizontal type is as follows: place a square piece of board on a pedestal and level it. The stile, or gnomon, may be cut from sheet metal having an angle equal to the latitude of the place. Fasten the gnomon to the board and line it up on the North Star by turning board and gnomon in azimuth (horizontal plane).



LAYING OFF THE COMMON HORIZONTAL DIAL

Figure 6: *Simple dials of this type give approximate sun time from which standard time may be worked out by means of the relatively simple corrections described in the text of the article*

AT near noon, when the shadow of the gnomon falls in line with itself, set your watch to 12 o'clock. As each hour comes around on the watch face, draw a line along the edge of the shadow cast by the gnomon. The next clear morning the hours may be drawn from sun-up to noon, and the half and quarter-hour divisions filled in at leisure.

Or the dial can be finished indoors as follows: First describe a circle *A* (Figure 6) with radius equal to the hypothenuse *h* of the gnomon. Then describe *B* with radius equal to the base *b* of the gnomon. Draw *CC* and *DD* at right angles to each other and subdivide each upper quadrant into six equal parts, connecting them with the center *O*. From the outer intersections draw lines parallel to *CC* until they cross lines from the inner intersections drawn parallel to *DD*. These new points of intersection are now connected with the center *O* and constitute the hours of the dial face, all other construction lines being erased.

It will be seen that the hours around noon are crowded more closely together than at six A.M. or P.M. This can be equalized by shifting circle *A* to *A'* and extending the hour lines to meet it, but the foot of the gnomon must remain at the first center *O*. Also, if the gnomon has an appreciable thickness, as is likely to be the case, the circles must be separated into semi-circles with centers a distance apart equal to the gnomon's thickness. The gnomon is attached to the dial face, it is leveled and then turned until the plane of the gnomon coincides with the meridian; that is, until it faces true north and south. This last may be done by lining up the gnomon on Polaris.

A DIAL so constructed gives apparent or sun time. To convert this into mean (or watch) time a table should be attached to the dial showing how many minutes are to be added or subtracted from the dial readings to give watch time. This table follows:

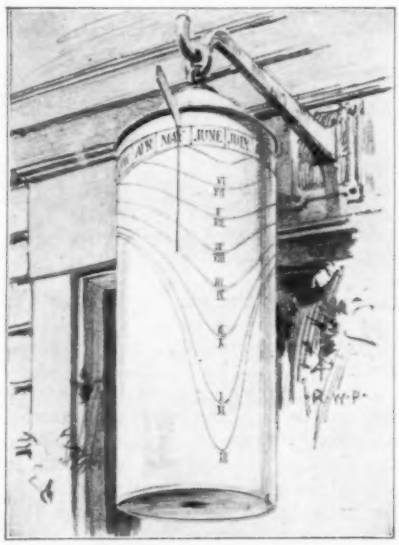
Month	1st to 10th	10th to 20th	20th to 30th
January	+7	+10	+13
February	+14	+14	+13
March	+11	+9	+6
April	+2	−1	−3
May	−5	−5	−4
June	−3	−2	+2
July	+4	+5	+6
August	+6	+4	+2
September	−3	−7	−9
October	−12	−13	−14
November	−13	−12	−10
December	−7	−3	+2

One more and final correction will give standard time. The numbers given in the table should all be increased (or diminished) by a time interval equal to the number of minutes the observer is east or west of the meridian on which his watch is running. For example, the watch of a person in New York keeps 75th or eastern standard time. But he is one degree east of the 75th meridian and therefore four minutes fast, and his dial readings, corrected from the table, will be four minutes ahead of his watch.

Another way to accomplish this last correction is to rotate the dial face (not the gnomon) clockwise by this amount. For instance, when the New Yorker's watch reads 12 noon, the sun has already passed his meridian and is over the meridian of Philadelphia and (disregarding for the moment the table correction) the shadow on his dial reads 12:04.

So, if the dial is shifted until the shadow recedes to 12 o'clock, and then securely fastened, it will agree with his watch, and hence this correction has been provided for and may be forgotten thereafter.

I WILL close with a reference to the cylindrical dial shown in Figure 7. In the one I have made, the curiously shaped curves were plotted on a sheet of paper, from data taken from the ephemeris of the sun, and then transposed to the cylinder itself. The computations required several evenings and covered many sheets of paper. If any one wishes to make a dial of this kind he will find full instructions in Earle's "Sun Dials and Roses of Yesterday," already referred to. The cylinder, when used, must of course hang strictly plumb, hence it must be properly balanced and provided with a swivel at the top. The stile can be pushed in out of sight when not in use.



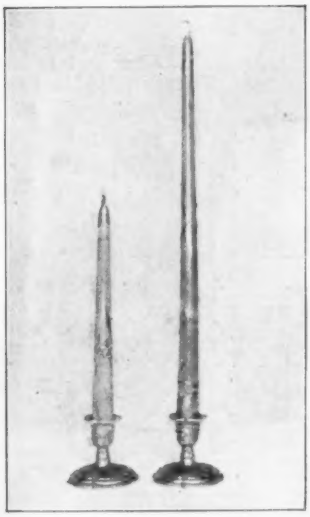
DIFFICULT TO MAKE

Figure 7: *Stile at top of cylinder is set to date and turned until shadow is vertical. Pyrenean shepherds use these dials today*

Inventions for the Household

CAN OPENER

Many can openers of this same general type have been invented during recent years, but this one, which is imported from Germany, is particularly efficient and easily handled. A knife edge under the knurled screw cuts a smooth-edged hole, while the ratchet-like toothed wheel firmly grips the outer rim. It works speedily without danger to the hands.—*Lewis and Conger, 45th St. at Sixth Ave., N. Y.*



WOODEN CANDLES

These candles, made for decorative purposes only, are of wood, and will not melt in hot weather. They look as well as wax candles and last indefinitely. — *Kozy Kandle Studio, Omaha, Nebraska*

ASH CUP

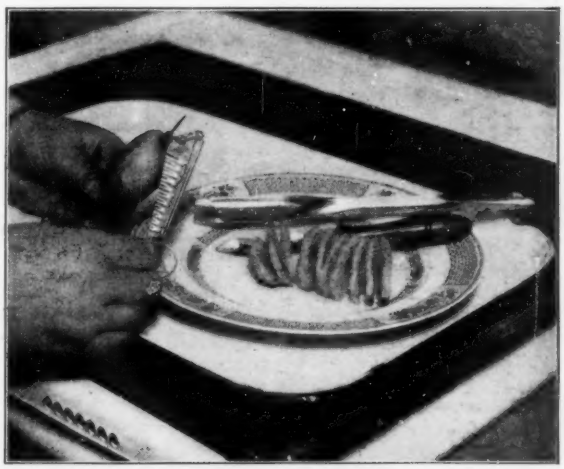
Equipped with snap-on fasteners, this ash receiver fastens to a floor lamp or a bridge table leg.—*Detroit Tire Cover and Specialty Co., 49 Selden Ave., Detroit*

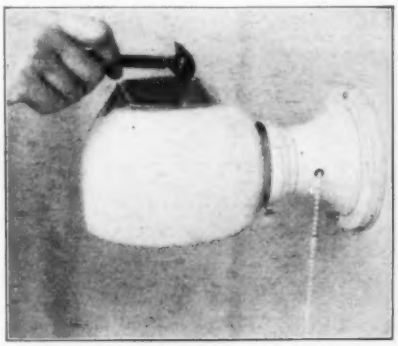
FOOD CHOPPER

This rocker blade with two wooden handles, imported from Czecho-Slovakia, is adapted to the preparation of chopped vegetables for small salads, et cetera.—*Lewis and Conger, 45th St. at Sixth Ave., New York*

POTATO SPIRAL CUTTER

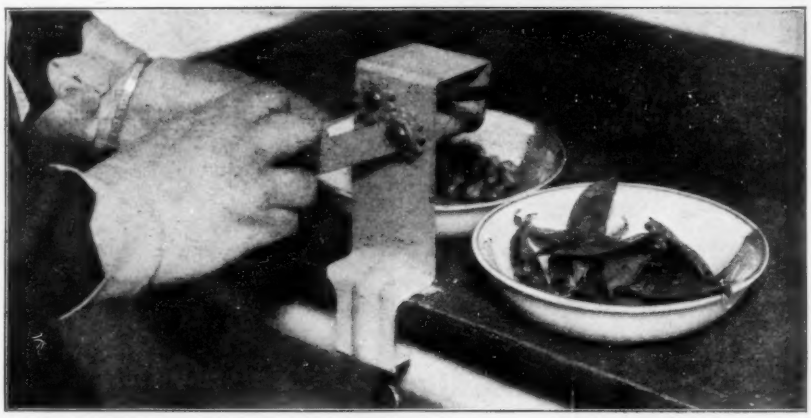
In using this French importation, a thin guide rod is first inserted in the potato; a sort of corkscrew attached to the end of the corrugated knife blade is then slipped over the rod; and the blade is turned around the potato. The screw "leads" the blade in a spiral, so that, finally, the potato is cut into a continuous spiral strip, ready for deep, or "French," frying.—*Lewis and Conger, 45th St. at Sixth Ave., New York*





RAZOR DRIER LAMP SHADE

This lamp shade over the man's shaving mirror should prove a welcome addition to his shaving outfit since it obviates the necessity of taking a safety razor apart for wiping. Heat from the lamp dries the razor as it rests in the recess above.—*Alfred D. Coons, P. O. Box 183, Berkeley, Cal.*



PEA HULLER

The principle utilized by the small boy who shoots peas into one's eyes by squeezing the pod has been made use of in this device. Insert the full pod between the two rollers, turn the crank, and the peas are squeezed out as the hull passes through the "wringer."—*Home Pea and Bean Hulling Machine Co., Marietta, Ohio*

Inventions New

COIN-SLOT GOLF GAME

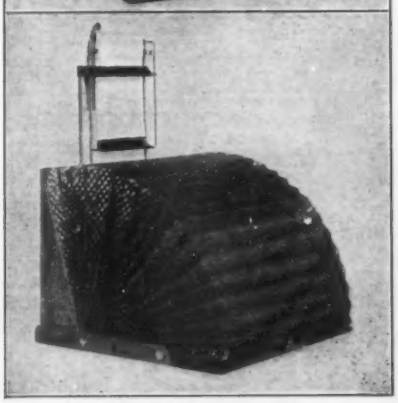
With this artistically designed amusement device, a regular nine or 18-hole game may be played. When a lever is pressed, the automatic golfer hits the ball which may make a hole-in-one or be "lost" in the painted lake. The player drives the ball first over the bunker into hole number 1; then over the bunker and brook into number 2; and finally, a long putt lands it in number 3. An automatic score-keeping device is attached. —*Chester-Pollard Amusement Co., 188 W. Fourth St., New York*

SELF-WINDING WATCH

Since this watch has no winding stem, the case is impervious to dust and dampness, and its lubricating oil does not, therefore, deteriorate. Overwinding and breakage of mainspring is impossible

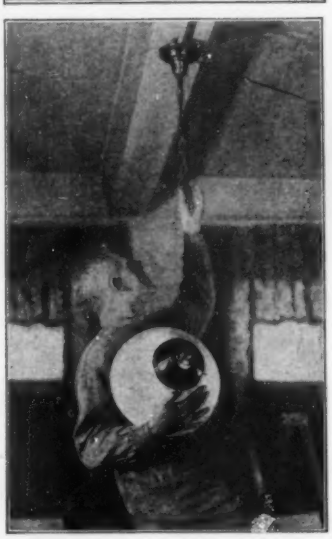
MECHANISM

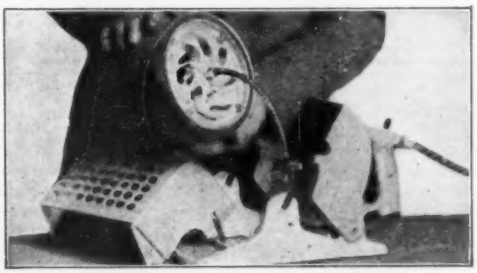
Body movement actuating a pendulous weight, keeps this watch fully wound at all times. Its simple mechanism is shown at the left.—*The Harwood Selfwinding Watch Company of America, Inc., 64 W. 48th St., New York*



TYPEWRITER COVER

Comparable to a roll-top desk, this cover for the typewriter that does not have its own folding desk, is strong, dust-proof, and disturbance-proof. The folding top, made of strong fabric folded like an accordion, may be locked in place when closed. When open, there is nothing to interfere with satisfactory typing. An attached copy holder adds to its convenience. —*Krieger Novelty Company, Lodi, Cal.*





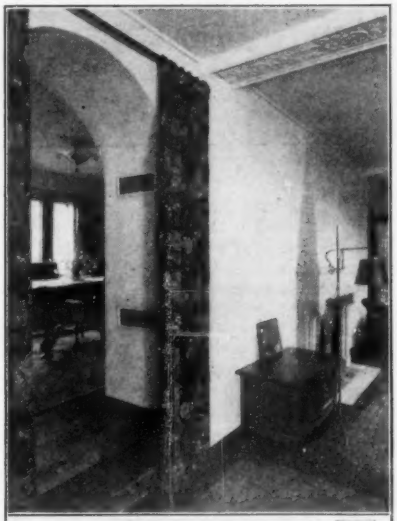
PORTABLE SANDER WITH VACUUM

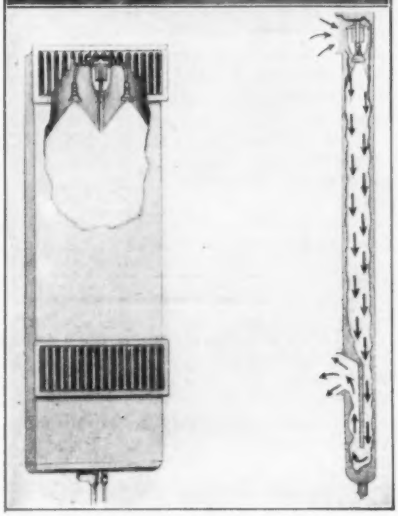
Designed and built for sanding table tops, lumber, base boards, et cetera, this new sander also has its own vacuum which takes up all the dust. Work may be passed over it as it rests on a special base. At the left, it is being used on a table top; and above, the man is holding the machine, disassembled, showing the sanding roll which is the only moving part. Speed is 1800 revolutions per minute. An attached bag catches the dust.—*The Reid-Way Company, Cedar Rapids, Iowa*

CONNECTOR SOCKET

This new socket may be used either at the ceiling outlet or at the hanging fixture. Two lugs on the plug end, one short and the other long with a loop for holding the weight, are arranged to be inserted into a slotted plug. Above is shown a close-up, and at the left a workman is removing a fixture, without dismantling it, to be carried to a more convenient place for cleaning.—*Artistic Lighting Equipment Association, 420 Lexington Ave., New York*

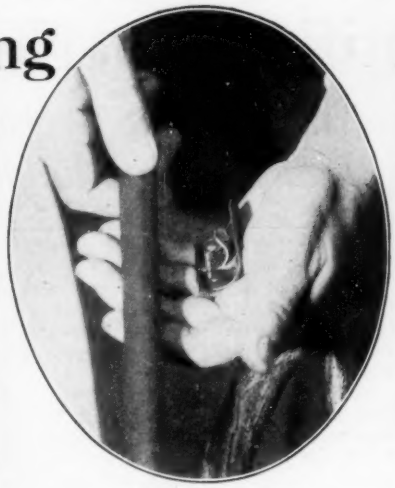
and Interesting





WASHED AIR SYSTEM

Above, under the arch, is shown an installation of the system sketched beneath. Air is drawn in through the upper register by the suction created by the water spray. The air is washed clean and thrown out at the lower register.—*Zephyr Washed Air Company, Minneapolis, Minn.*

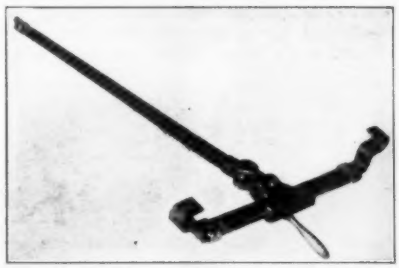


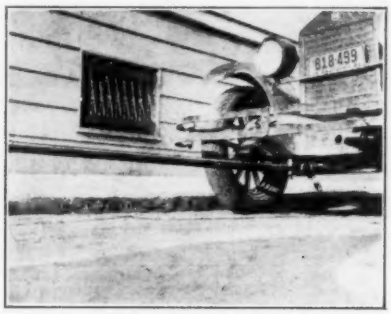
GOLF CLUB GRIP

Teachers of golf stress the necessity of holding the club in the fingers of the left hand. This device makes you take right grip because it automatically lowers the left hand and turns it palm downward. It has the effect of strengthening the left hand and controlling swing.—*The Rite Grip Co., 335 Richardson Building, Toledo, Ohio*

WINDOW-VISOR HAT

A section of green pyralin is inserted in the visor of this sport hat to shield the eyes from the direct glare of the sun. Wearing it, an automobilist may drive safely toward the setting sun, or a golfer may watch the flight of his ball without straining his eyes. The hat is adjustable to all head sizes. —*Superior Hat Co., St. Louis, Mo.*



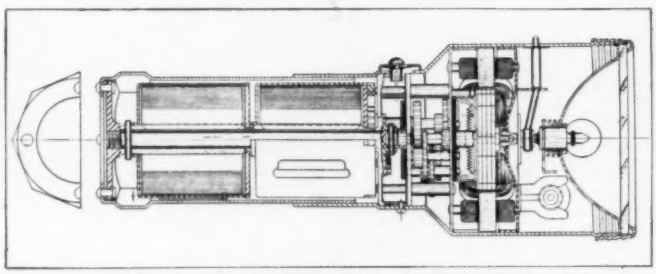


◂▲ TOWING ATTACHMENT

In the illustration at the left is shown an adjustable steel clamp which, attached to the front springs of a car, provides a connection for a towing bar. It is rigidly fastened so that the towing bar cannot damage the front apron while the stiff bar prevents a smash in case of a sudden stop. Above are shown two photographs of the device in place.—*Kimmerle Brothers, 226 Eleventh St., San Francisco*

WINDING

The dynamo flashlight, cross-section of which is shown at the right, is wound by turning the two ends in opposite directions



A NEW FLASHLIGHT WITH ITS OWN GENERATOR

Sectional view of the flashlight that makes its own electricity. The generator is operated by a spring motor which runs for nearly three minutes after winding. Pressing the button starts the generator, which produces electricity at two and one half volts. It is not affected by dampness, will flash under water, and will last indefinitely.—*Campbell Manufacturing Co., Long Branch, N.J.*

FLASHING

On pressing the button, one hears a hum as the spring-driven generator of this flashlight goes into action, giving a bright light

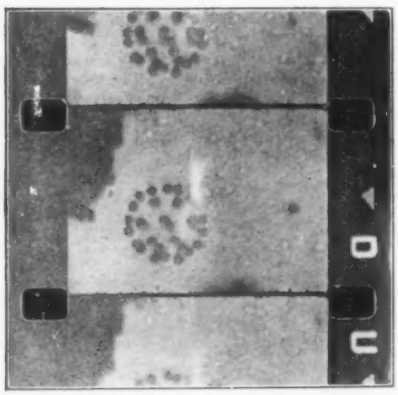
The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Similar Birthmarks in Five Generations

A FAMILY in which nine individuals have been spotted by birthmarks in five generations was described by Dr. Arthur H. Estabrook, of the Eugenics Record Office, at the meeting of the Eugenics Research Association in New York recently. The significant point stressed by Dr. Estabrook was that the spots occurred in similar parts of the body in the different generations; so that apparently, not only the spots, but their location as well were inherited.

Certain types of birthmarks may develop into skin cancers, Dr. Estabrook pointed out. For that reason the inheritance of birthmarks is of particular interest, in connection with the possible inheritance of skin cancers.—*Science Service.*



"Movie" of a micro-organism found in pond water. Made up of green dots, the circle revolves constantly

Motion-Picture Photomicrography Simplified

NO longer is motion-picture photomicrography confined to the laboratory of the specialist with thousands of dollars worth of equipment at his command. Two little devices which have recently appeared, make this work remarkably easy for the owner of any 16 millimeter amateur motion-picture camera, or for the owner of any other motion-picture camera. With the aid of these two devices, moving picture studies of microorganisms may be made easily.

The first attachment is a prismatic device which rests over the microscope ocular. By means of a partly silvered prism, 1 percent of the light is transmitted to the eye for controlling the subject, while 99 percent goes to the film to register the image upon its sensitive surface.

This adapter has an eyepiece, the field of which is a pale green. In this field there is a colorless rectangle which coincides with the camera field. These colored fields are interchangeable for use with either amateur or professional cameras or for still cameras.

The second device is a prismatic focusing device which enables the operator to focus the image accurately upon the camera field (film), to make sure that the visual and camera foci coincide.

Using a conventional microscope arc lamp and a very small aperture in the microscope condenser iris diaphragm, the automatic cameras may be operated at normal speed with the assurance of securing a fully exposed negative.

Remarkable results have been secured with this apparatus by amateurs at their first trial. This success opens up a promising new field to educators and to students, as well as to the great army of amateur cinematographers who are interested in this new work.

Powerful Wind Motor Generates Electricity

A MACHINE using neither fuel nor electricity, which generates 150 to 175 horsepower, has been erected and is being extensively tested in the region of the Coachella Valley, California. The success of the experiment which has been carried on for the past few months indicates that this device can utilize the power of the wind as economically as turbines can utilize water power.

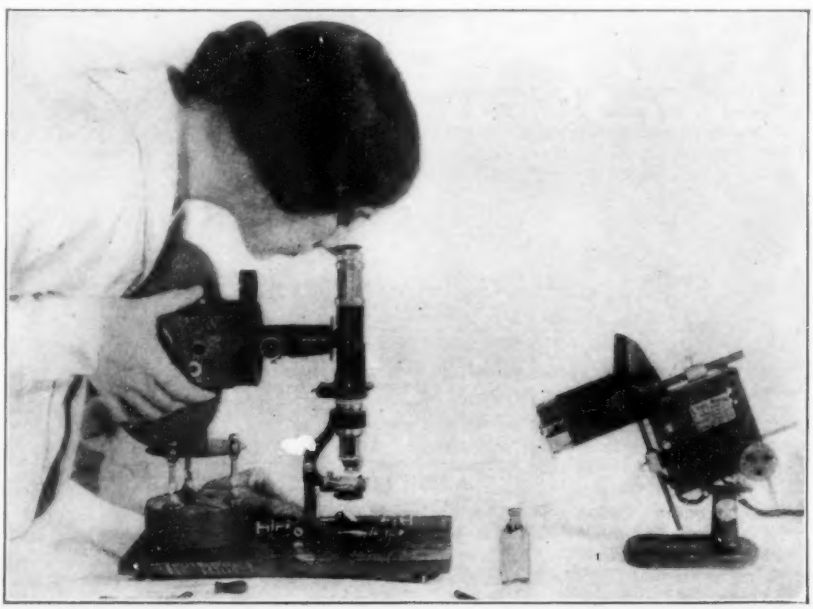
This machine, known as a wind motor, consists of a funnel-shaped tube of heavy sheet metal approximately 100 feet long, the large end being about 15 feet in diameter. The funnel is mounted on a pivot and supported by a massive steel frame of riveted angle iron. This frame rests upon a circular double track and the mounting enables the machine to be pointed with its large end toward the wind. A draft of air is developed into a 10 to 20-mile wind. As it passes through the funnel, it propels a fan which is connected with the generator. This generator and the controlling mechanism are contained in a sheet-metal housing mounted within the angle-iron frame beneath the funnel. The machine contains several tons of steel.

Tests made with this machine together with accurate weather reports showing wind averages over a period of years, have prompted the inventor to project a series of them at favorable points throughout the west. It is proposed to locate these in mountain gaps and other points where wind is prevalent. In the locality where this initial installation has been made, there is an operating wind 90 percent of the time.

If the proposed units are not too widely separated they will all be placed on the same electrical circuit, thus providing a source of continuous power. The plan is to make the new wind machine about four times as large as the present model.

New Dust-proof Electric Motor

ALTHOUGH the standard open frame squirrel-cage motor meets most of the requirements for ordinary service, it has certain disadvantages which become rather serious in many applications. For example, when it is operated in a dust-laden atmosphere, its air passages soon become clogged. This causes overheating unless the motor is frequently cleaned. An even



The new "micro-movie" equipment in action. Making animated photomicrographs that can later be thrown on a screen and studied at leisure

more serious condition exists in cases where the air is laden with metallic dust—particularly iron dust — because this metallic dust works into the windings and may in time cause a breakdown of the insulation.

Several attempts have been made to overcome this difficulty by the development of enclosed, self-ventilated types. One recently announced by Fairbanks Morse and Company has also an interesting air cleaner device.

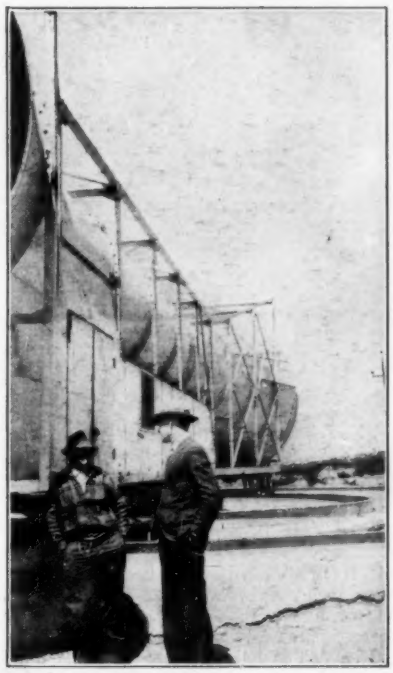
This motor has a standard stator core and windings and a standard rotor mounted in a supporting shell with an annular air passage between the outside surface of the stator core and the shell. Winding shields are provided so that the stator windings are totally enclosed, thereby preventing any dirt from gaining access to these windings. Cooling air is drawn through an inlet opening at the free end of the motor by means of a special type fan which also functions as an air cleaner. The clean air is blown across the winding shield at the free end of the motor, through the annular air space, then across the outer end of the stator core laminations, thence across the winding shield at the pulley end and out through openings in the pulley end-bearing arm.

The fan is of the closed impeller type and is so constructed that the foreign particles are thrown out by centrifugal force, between the edge of the outer shroud and the supporting frame. A perforated guard is placed around this fan-cleaner and is carried by the supporting frame.

In this variable leakage, double squirrel-cage type motor, the current in the inner winding at starting is choked by means of iron rods. The instant the motor is connected to the line, these rods, in each rotor slot between the inner and outer bars, are pulled down towards the inner bars, closing the small leakage gap in the rotor iron. This almost completely chokes the current in the inner low resistance winding by forming a complete iron circuit around each inner bar.

This choking action on the inner winding forces practically all of the current to flow in the outer high resistance winding at starting, thus producing a high starting torque with a low starting current. As the rotor accelerates, the iron rods are thrown out of the leakage gaps by centrifugal force, thus removing the choking effects from the inner winding when the motor is running.

The important advantages of this type of motor are: 1. It is completely self ventilated and cleans its own cooling air by means of a built-in automatic air cleaner; 2. That it is impervious to dust and dirt in the air; 3. It is built in the same frame diameter as standard motors of corresponding horsepower; 4. No air piping of any kind required; 5. Will operate in the dustiest locations without requiring any blowing out; 6. Reduces fire hazard as the windings are totally enclosed and the air for ventilation does not come in contact with them; 7. It requires no more attention than a standard ball-bearing motor.



Looking toward large end of wind-power generator showing circular track on which it turns, and the housing for the machinery

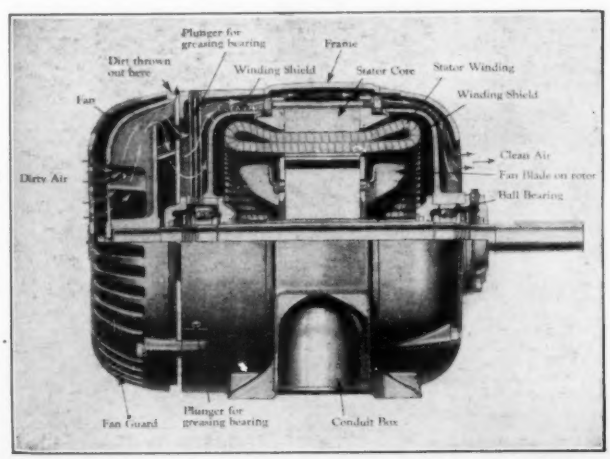
View of the wind-power generator installed in a California valley

Harpoon Gun For Fish

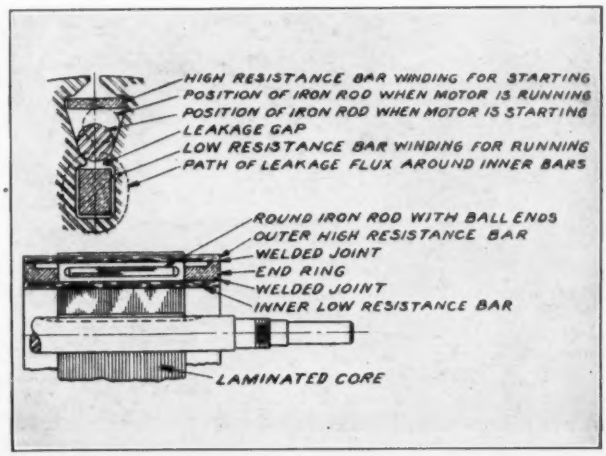
A GUN, with an attachment for harpooning fish, the whole somewhat similar in operation to the whale harpoon gun, has been invented in France. Since this gun is to be fired from the shoulder like any ordinary gun, it was necessary to make it as light as possible. The total equipment consists of the gun, a harpoon, a line, and a float, all compactly arranged together.

The gun is of a standard French type and is not changed in any way except that two screw-like grooves have been cut in the end of the muzzle. Two studs on the front of the harpoon slide in these grooves, thus imparting a rotating motion to the harpoon as it leaves the gun. A tube is attached to the muzzle of the gun below the barrel, to hold the round metal can which, in turn, holds the line and the float. The light can container is open at the rear end but is closed in the front, having only a small hole through which the line is drawn. The line is attached to the harpoon just behind the dart. A length of ash is fitted to the dart, giving a total length of about 16 inches.

The standard cartridge from which about half the powder charge has been removed,



The windings of this motor are totally enclosed with winding shields, and the fan is designed to throw out dust and dirt


HIGH RESISTANCE BAR WINDING FOR STARTING
POSITION OF IRON ROD WHEN MOTOR IS RUNNING
POSITION OF IRON ROD WHEN MOTOR IS STARTING
LEAKAGE GAP
LOW RESISTANCE BAR WINDING FOR RUNNING
PATH OF LEAKAGE FLUX AROUND INNER BARS
ROUND IRON ROD WITH BALL ENDS
OUTER HIGH RESISTANCE BAR
WELDED JOINT
END RING
WELDED JOINT
INNER LOW RESISTANCE BAR
LAMINATED CORE

Section showing improvement in double squirrel-cage motors. Loose iron rods are inserted in the rotor slots between bars

The new French harpoon rifle with full equipment ready for firing

will, it is claimed, drive the harpoon through a one-inch pine board at a distance of about 80 feet; and at 160 feet, the point will show through such a board.

If a fish is hit, the cord unwinds until finally the can and float are drawn out, fall into the water and serve to locate the fish. If the fish is missed, the harpoon merely hits the water and may be recovered by pulling in the line.

This gun and its equipment is manufactured by Nationale d'Armes, 18 Rue de Roanne, Saint-Etienne, France.

Device for Solving Triangles Mechanically

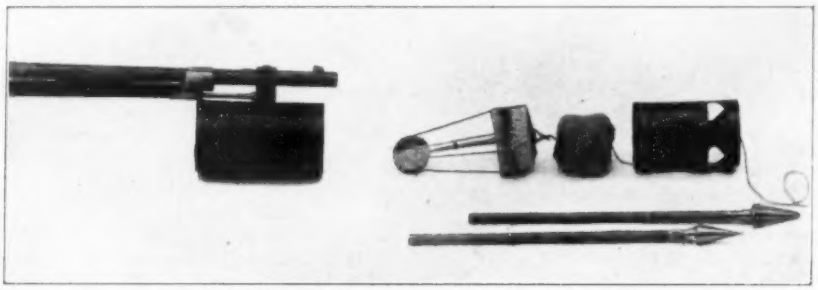
DR. J. E. ROWE, Director of the Extension Department, College of William and Mary, has recently patented an instrument which may be called a "slide rule" for triangles. It was developed to meet the distinct demand for an instrument that would solve triangles and other polygons mechanically.

This device has been named the trinometer. It is simply an adjustable triangle whose parts may be fixed at given values, and the result read directly from scales. Its operation is very simple, involving no knowledge of logarithms or trigonometry. The fundamental principle involved is that of similar triangles.

In each of the simple instruments shown in the accompanying illustrations, the triangle to be solved is *ABC*. On these instruments, the two angles *A* and *B* are read directly from circular scales and the lengths *a*, *b*, *c*, *AD*, and *h* are read directly from straightway scales at the points indicated. The third angle is found as the supplement of the other two. These are called plainscale trinometers because no verniers are used in reading the circular or straightway scales.

Given two sides and the included angle of a triangle, it may be solved as follows: (Refer to the illustrations.) Slide bar *b* through its sleeve until one given side is recorded at the point marked *"read b;"* lock with screw. Slide the mechanism *B* along the base bar until the second given side is recorded at the point marked *"read C;"* lock with screw. Slide *a* through its sleeve on the mechanism *B* until the given angle is recorded at the point marked *"read angle A;"* lock *a* or the angle *A*. Read *a* and angle *B* at the points marked. Then *C* equals 180 degrees minus *A* minus *B*. Now slide *D* along the base bar until the angle *ABC* equals 90 degrees. Read the altitude *h* and *AD* at the points indicated. Area is then one half *hc*. Other triangles may be as simply and easily solved without recourse to trigonometry or trigonometric functions.

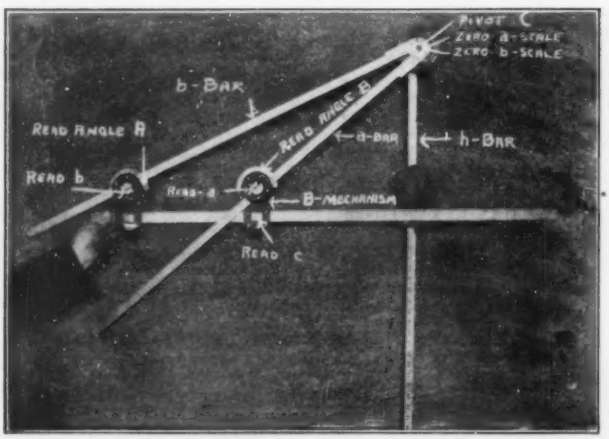
The possible applications of this instrument to problems of everyday life are as follows: to simplify computations in surveying; to be the basis of a set of automatic surveying instruments; to be applied both directly and indirectly as range-finders in artillery on land and at sea; to have constructed upon this instrument as a basis, instruments for determining the position of a ship at sea or of aircraft, and to enable an airplane to locate itself; and to aid in the teaching of mathematics in such a way as to humanize and practicalize the subject. In fact, it is claimed that any phase of engineering involving the solution of triangles may be simplified by its use.



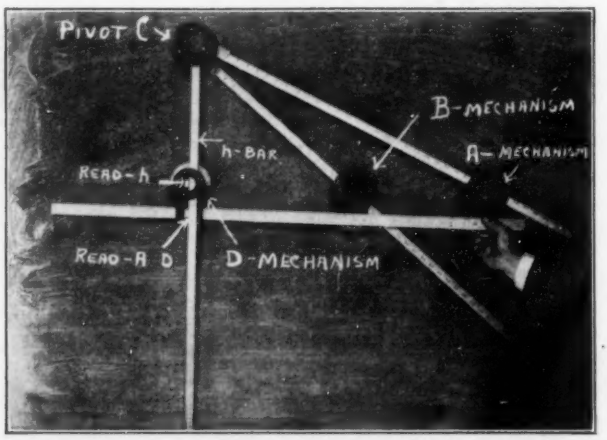
Close-up of the equipment for the harpoon rifle showing the container permanently attached, the float, cord, can, and two darts

Concrete Mats for River Bank Protection

ARTICULATED concrete mats are now being used along one section of the Mississippi River to prevent severe



Front view of the trinometer invented and patented by Professor Rowe, showing the various mechanisms, scales, and bars. It is said to be quite accurate



Back view of the trinometer. This is fully described in the accompanying text in which a typical example is worked out without the use of trigonometry in any way

cutting away of the banks on "outside" curves during periods of high waters, according to an article by W. W. DeBerard, in a recent issue of *Engineering News-Record*. Formerly such revetments were made up of willow mats, but it was found that these concrete mats could be laid for 225,000 dollars a mile against a cost of 300,000 dollars per mile for those made of willow.

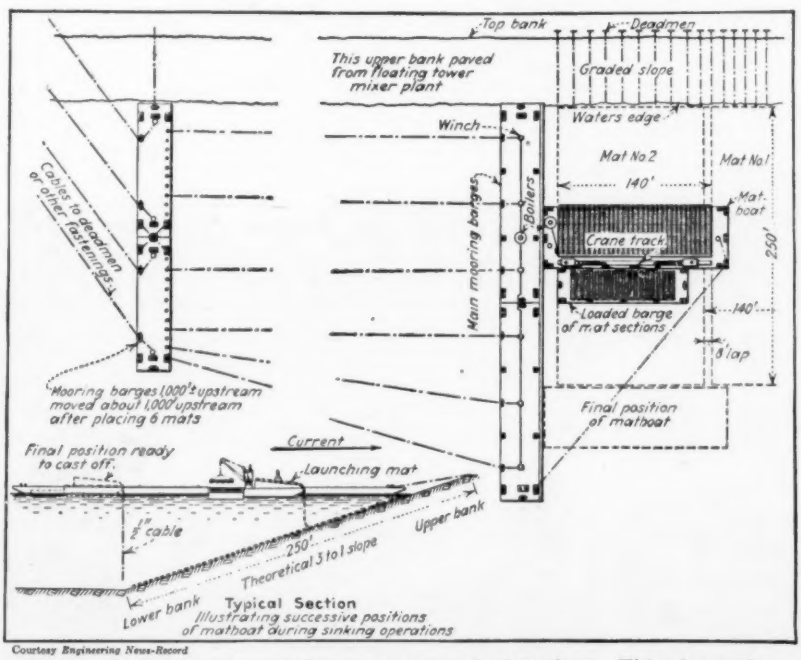
The articulated type of concrete mat is made up of strips 25 feet long containing 25 slabs, each three inches thick, 11 inches wide, and 3 feet 11 inches long, these being strengthened and connected with wire mesh. They are cast on barges, one layer being placed on top of another as fast as the concrete sets, sheets of treated paper being placed between to prevent sticking. Setting time of the concrete varies from six hours in summer to 24 hours in winter.

In laying these mats, a long steel barge loaded with them, having a skid on one side, is hauled close to the river bank and parallel to it. The upper end of the barge is fastened by cables to a set of main mooring barges which project outward into the river. These barges are connected by cables to an upstream set of mooring barges by cables attached to winches by which the main barges are shifted as the work proceeds. The mat cables are then made fast ashore and the first mat section laid down as the mat barge moves away from the shore. Another section is laid upon the skids, its cables fastened to those of the first, and the launching process continued until the launched mat extends a sufficient distance outward from the bank along the river bed. Having thus laid a mat 140 feet wide and 200 to 300 feet out into the stream, the whole apparatus is shifted to lay another mat upstream. The process of laying mats and shifting position of the mat barge is continued until adequate protection is effected.

By this method sections of the river bank have already been protected successfully. According to the present method of operation, the sinking plant can easily place an average of 70,000 square feet in a day. For average widths of revetments this covers about 265 linear feet per day or just one mile each working month.

Courtesy *Engineering News-Record*

Cutting the cables of a mat section already laid, preparatory to moving to a new position upstream



Courtesy *Engineering News-Record*

Plan and cross-section of the concrete-mat-laying plant. This shows the main, mooring, and mat barges, and other equipment. It is self-explanatory

"Lexington" Sets New World's Records

AFTER breaking the world's ship speed record three times in as many days, the United States aircraft carrier *Lexington*, one of the mightiest ships of her kind afloat, made a further record for the speediest passage from California to Hawaii when she went to Honolulu in June to join the fleet. She made the 2228-mile trip from San Pedro, California, in 72 hours, 34 minutes. The best previous record was made by the light cruiser *Omaha* in 1923 when she steamed the 2091 miles from San Francisco to Honolulu in 75 hours, 40 minutes, and 40 seconds.

On the first day out, the *Lexington* broke the world's distance record for 24 hours by covering 700 miles in that period. This is 10 miles better than the best day's run of the *Omaha*, previous holder of the record, and 24 miles better than the record for merchant ships made by the *Mauretania* in 1911.

During the second 24-hour run, the *Lexington* logged a total of 742 miles. The remaining distance of 786 miles was made in 24 hours and 34 minutes, so it is calculated that for the third consecutive 24-hour run she traveled 770 miles.

Mr. Gomez and his tiny motor and elevator mechanism which stands beside a pencil for comparison

Miniature Electric Motor

A WHOLE tribe of "midget" motors seems to be springing up. Since we published an item concerning one in the March issue, another was called to our attention with the claim that *it* was the smallest in existence, and we mentioned it in the June issue. A few days ago, Gabriel Gomez, a student from Colombia, South America, now residing in New York, personally brought in a third. While this third one is not *the* smallest, it is the first of the tribe that the editors have had the fun of examining and operating. It *is* small, and it certainly does hum.

Mr. Gomez says that he came to New York some months ago to attend an electrical school. For a while he worked with a watchmaker and there became familiar with the delicate machinery used in making or repairing watches. After months of study in the electrical school, his father desired to know how much he had learned and accordingly promised him a trip to Spain if he could make a tiny motor that would run. It took Mr. Gomez just two months of spare time to complete the job.

This latest member of the tribe is slightly

(*Please turn to page* 177)

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Flight Without Power

THE basic principle of a kite is that it is maintained stationary relative to the earth, while the wind sweeps by it, so that lift follows from the availability of a relative wind. If the kite is loosened from its moorings, it first assumes the forward velocity of the surrounding atmosphere and then drops to earth.

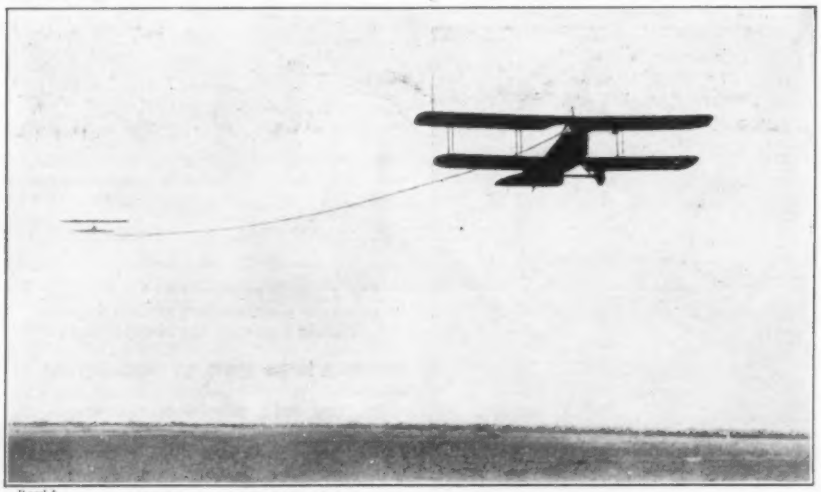
A glider can only remain aloft in an upward current of air. If the wind is steadily horizontal, it must sink to earth sooner or later.

A German, Wolfmüller of Munich, makes the very ingenious suggestion that by the use of two gliders, a kite could be obtained which would not have to remain stationary relative to the earth.

There is almost always in the air a velocity gradient with altitude. The wind at 500 feet above the ground is greater than the wind at 200 feet, let us say.

Now if we imagine two gliders, one considerably higher than the other, and allow that there is such a velocity gradient, then we can conceive that the entire system will be carried along by the wind at some speed between the velocity of the upper wind and the velocity of the lower wind. The upper glider will receive lift if it faces the wind, the lower glider if it has the wind on its tail, as will be apparent from a little reflection, and the entire system stays aloft and travels in the general direction of the prevailing wind!

Calculation will probably show that the available lift will be very small, but theoretically at least the notion is plausible.



P and A

A glider being towed by an airplane. See photograph below

Towing Gliders

TOWING glider targets has been a practice of the United States Army Air Corps for many years. Several years ago, Anthony Fokker exhibited at a Paris Aero Show an engineless machine which was to be towed behind an airplane, with the general idea that goods or mail could thus be delivered at intermediate points without interrupting the flight of the towing airplane. It has remained for the Germans however to experiment with the idea.

The Raab-Katzenstein glider, a small biplane of some 180 square feet in surface, was employed in these tests. The glider was attached to the towing machine by a long cable fixed to the center section of the plane and to the nose of the glider. Quick release gears were fitted on each end of this cable so that the pilot of either machine could free it as required, and a light tubular guard was fitted above the fuselage of the towing plane to keep the cable clear of the rudder and fin.

At the first attempt to get off, the lightly loaded glider left the ground and climbed rapidly before the towing machine had attained flying speed. The glider pilot released himself and landed. A second attempt was more successful.

It remains to be seen however whether the process will be practical in rough weather. Owing to the distance apart of the craft they may be struck by gusts of different direction and intensity and peculiar problems in dynamics and stability will have to be studied and met.

Air Terminals

THE French lead the world by their imagination. It is not surprising that the full conception of what an air station should be comes from a young French architect, Maurice Chauchon, who recently arrived in New York on a traveling fellowship of the American Institute of Architects. His prize-winning plan for an airport will be embodied in a proposed terminal at Pau, France, 50 miles from Bordeaux.

The air station will be 370 feet wide and 260 feet long. The huge arches will be, however, only 40 feet high at their center portion, since even the largest planes are comparatively low in overall height. Tractors will pull the planes into position inside the hangars, and passengers will thus be protected from weather conditions. The huge hall will contain arrival and departure platforms, air mail service offices, customs house, the weather service, restaurants, cafés, et cetera.

There will be provided facilities for testing engines, underground fuel reservoirs, garages for automobiles, rooms for pilots and mechanics and other employees, a power station and every other possible convenience. Daylight illumination will be provided by a roof of glass slabs set in reinforced concrete. At night two vertical beams of 1,000,000 candle power will guide the pilots. Two lateral beams will sweep the ground for landing. The name of the airdrome will be sunk in the ground and illuminated. As a whole, the plan is magnificent and realizable.

First Tourist Air Cruise

THE American Aviation Tour of Europe is announced under the auspices of the North German Lloyd, the Luft Hansa,

P and A

A glider being attached to the end of the tow line. Notice the long tube above the fuselage of the plane to keep the tow line clear of the rudder and fin

This *grainless* wood board is writing a new page in the drama of progress!

Possesses remarkable workability—won't crack or split. Revolutionizing methods of manufacturing in many industries. New uses discovered almost every week. Send for large free sample and find out what Masonite Presdwood will do for you.

FOR SIGN BOARDS

Here is a creation of modern inventive genius that is challenging the imagination of manufacturers in scores of industries, and that has already made it possible for a number of them to reduce their operating costs, improve their products and broaden their markets.

A genuine all-wood board which is absolutely *grainless!* A board that positively will not crack, check, split or splinter. A board of uniform strength and truly remarkable workability! —— That, briefly, describes Masonite Presdwood.

And yet these are only a few of the many advantages of Presdwood. It is very dense and tough. It is highly resistive to moisture. It has a smooth, attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Can be cut and milled

Presdwood is simply wood torn apart and put together again. It contains no foreign substance; not even a chemical binder. So it cannot damage tools.

Presdwood comes in a four-foot by twelve-foot size. It can be used on any woodworking machinery. It can be cut out, punched, die cut and milled. In fact, Presdwood is adaptable and workable almost beyond belief.

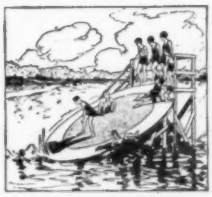
From doll houses to bridges!

There seems to be practically no limit to the uses for Presdwood, and new uses are being discovered week after week.

Candy makers are now using Presdwood for starch trays, and in the Chicago Art Institute it is backing and protecting rare works of art.

Store fixtures of many kinds, incubators, clothes hampers, bedroom screens and fire screens are made of Presdwood; so are work-bench tops, bread boxes and concrete forms.

You will find Presdwood as paneling in the new Pullman cars of several leading railroads; you will find it made into tension boards for many radio speakers. Large halls and pavilions have floors of Presdwood; and it is already beginning to go into fine office buildings, apartment buildings and homes for the same purpose.



FOR SAFETY WHEELS

Toys are made of Presdwood; trunks, wardrobes, bank vaults, and telephone booths are lined with it.

There are kitchen cabinets, shelving, and office partitions of Presdwood; thousands of feet of it are used in making movies; there is now a demand for it in the construction of dams.

In brief, Presdwood uses range from doll houses and invalid trays to bridges and flumes!

Withstands the wear of all outdoors

Out in the open country—there, too, Presdwood is proving what an enduring, adaptable material it really is. Water, wind and scorching sun have little effect upon it, even when it is left unpainted. Steadily, persistently, it withstands wear and tear that have wrecked many another material in a comparatively short time.

Presdwood is being used for speed boats—alike on the Gulf of Mexico and the lakes of Wisconsin. Campers' tables are made of Presdwood; so too are safety wheels for bathing beaches, and particularly signs—all kinds of signs. Holstein and Guernsey Breeders, for example, are using Presdwood sign-boards in Wisconsin, Minnesota, Iowa, Nebraska, the Dakotas, and as far west as Idaho.

And so the list of Presdwood uses might be continued for many paragraphs. We suggest that you put this *grainless* all-wood board to the test yourself. It may be exactly the material you are looking for. Write today for large free sample. It will be sent promptly on request.

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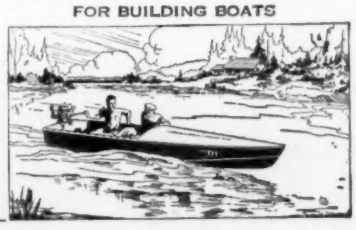

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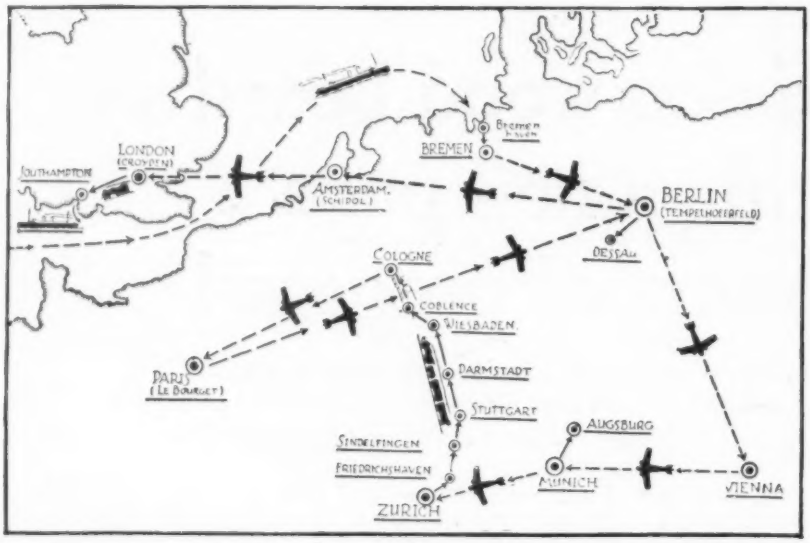

Itinerary of the American Aviation Tour of Europe, under the auspices of the Luft Hansa Imperial Airways, the French Air Union, and other organizations. Regular scheduled flights are to be started during the coming fall

Imperial Airways, the French Air Union, and other powerful organizations. It will cover 2700 miles in the air, through Germany, Austria, Switzerland, France, Holland, and England. Famous factories in Europe will be inspected, passengers will travel in a variety of planes and for a change will travel short sections of the journey by rail. The success of the tour this fall will be awaited with interest.

Law of Aviation

THE principles of law apply in aviation, just as in any other human activity. But there must be, nevertheless, new statutes, definitions of new principles, precedents to be set up in the courts. And therefore books on aviation law are beginning to appear.

Fixel's "Law of Aviation," (published by Matthew Bender, Albany) makes interesting reading. At the first peace congress, called by the Emperor of Russia, the throwing of projectiles from dirigible balloons or any other aircraft was prohibited! The earth can be appropriated, said the lawyers, the air cannot; it is in the nature of common property. There are now International Aviation regulations, the Air Traffic Regulations of the Department of Commerce, and state aviation laws which are patterned after the Federal regulations for the most part.

Fixel's book will be of interest to aircraft operators as well as to the lawyers.

The Sportsman Aloft

IT is most interesting to read what George M. Pynchon, Jr., noted sportsman and financier writes in the *Sportsman*. People professionally interested in aircraft have no false modesty in airing their views. But it is seldom that a member of the general public will set down his views on aviation on the printed page. Discussing the first solo flight, Mr. Pynchon says:

"The much advertised first solo, a curse to everyone who has to listen to the soloist, is all that, and a good deal more than, it is supposed to be. The front cockpit looks awfully empty, the ship feels different—because it is lighter—and there are usually a lot of people on the ground waiting to see the carnage when it lands. But the white handkerchief tied to the tail of one's machine is a challenge and there isn't any carnage, and it's probably the best landing one will make in a month, for later one has relapses when the wheels hit the ground at 60 miles an hour, the ship bounces into the air and one blesses the sturdiness of the undercarriage."

Loops, according to Mr. Pynchon are always an agreeable diversion. Hours of practice are advocated to learn dead stick landings. Flying is not expensive for the would-be sportsman-flyer. Good planes are available at 3000 dollars. Although these are of the open cockpit type, they provide more feel of the air than the larger and more expensive cabin types. On the whole, Mr. Pynchon thinks flying safe for the sportsman, provided he takes due pains to learn and takes no unnecessary risks. A most encouraging article both for the aviation people and for the would-be airplane owner.

A Collapsible Chock

WOODEN chocks for airplanes have been used for many years. They are placed at the front of the wheels to keep the plane from moving until the pilot has had a chance to try out his engine and warm it up when necessary. The wooden chocks in use thus far have been somewhat clumsy affairs however, and are hard to stow on board a small plane.

Now an English firm has brought out a metal chock, consisting of three plates of stout duralumin, hinged together and so arranged that they may be either opened out to form a triangular block of the same section as usually given to wooden chocks, or folded flat for transport. When folded they take up very little space and should be very useful for private cross-country flying which may necessitate landings in isolated places away from regular airdromes.

A Novel Test Bed

THE *London Aeroplane* publishes a brief description of an entirely novel engine test bed. An engine test rig requires dynamometers, instruments of every variety, an observer's room, et cetera. When testing engines in full flight it is almost impossible to carry all the apparatus required. On the other hand, in ground testing it is difficult to reproduce the actual conditions of flight where air is flowing at high speeds past the engine and propeller, particularly when the horsepower is very high.

The Dornier Company of Germany has met the situation in an ingenious fashion by mounting the engines to be tested in a hydroplane capable of over 75 miles per hour. The floating test bed provides every facility for testing the two huge Jupiter geared engines with tandem disposition of engines and propellers. In particular, the new apparatus should provide much useful engineering data on the efficiency of tandem airscrews.

A Submarine Aircraft Carrier

THE submarine has already attained an astonishing degree of size and independence of action, and is a foe dreaded by the largest battleship. It becomes a still more formidable war vessel, when it can carry an airplane on board. Our photograph is the first released of the British submarine *M-2* on which what was formerly a 12-inch gun turret is now used as an airplane hangar. The seaplane is pulled out of its hangar by man power, slides along the deck and is ready to rise from the water in a very short time.

International Newsreel

The former 12-inch gun turret on the British submarine *M-2* is now used for the hangar of a seaplane. The latter can be placed in action quickly

The Beauty of MICARTA

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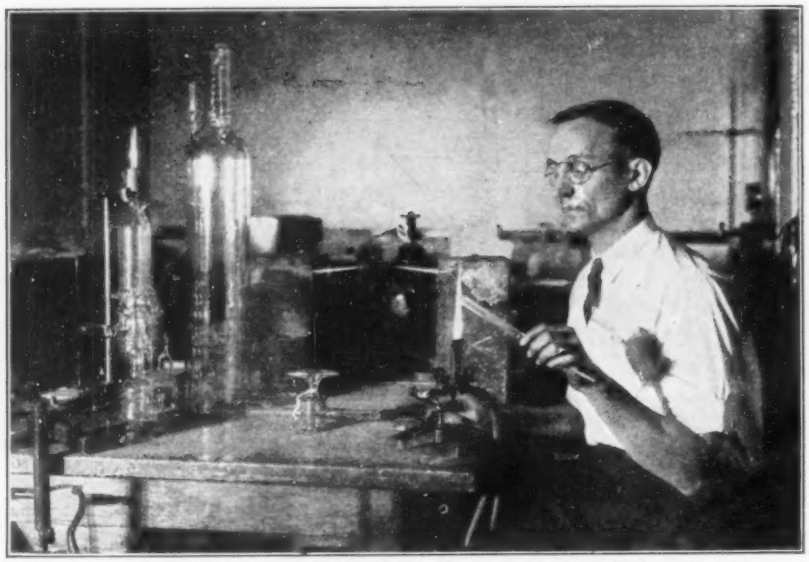
Accelerated Test of Paint Checks Exposure

ACCELERATED tests for determining in advance the life of a paint film and its ability to protect metal surfaces beneath it have frequently been proposed, and on the basis of such tests many statements as to the particular value of particular paints have been made. It is very seldom that such a quick test is compared with definite exposures of similar samples to the weather and when such a comparison is made and results in a complete check between the two, one must be impressed. In 1913 Norman A. Dubois conducted a series of accelerated tests on structural paints and in four days reached conclusions as to the relative values of various formulas for compounding protective coatings. At the same time similar samples of paint were applied to panels which were exposed to the air and 11 years later these exposed panels confirmed accurately the conclusions drawn from the four-day test. The close check between the two results confirms the theory as well as the practice employed by Dubois. In describing his work in 1913 in *Industrial and Engineering Chemistry*, Dubois said in part:

"The problem is a physical one rather than a chemical one, and a comparison of paint films as to their relative obstruction to the diffusion of gases will tell more regarding their value as protection against corrosion than a study of inhibitive action of their pigments."

To prove this theory, panels painted with the various coatings under consideration "were exposed in a closed box with a glass front in order that the conditions could be carefully watched. Oxygen and the corrosion-accelerating gases in the atmosphere were passed into the box through wash bottles, to insure a slow but steady current, and a small quantity of steam was admitted to keep the atmosphere within the box always very moist, but not sufficient to raise the temperature materially. The panels were examined from day to day, and removed when it was judged that further exposure might obliterate the truths for which we were seeking. The test was completed in four days. Sulfur dioxide was the principal gas used."



In the research laboratories of the Westinghouse Electric and Manufacturing Company, much glassware is necessary. Above is shown Christopher Kirwer, expert glass blower, who turns out many forms of complicated apparatus

The exposure test of the same paints was described by Edward D. Gregory in a recent issue of the same publication, who says in part:

"A portion of each of the samples submitted to Dubois was sent to one of the large railroads of the east, and their test department painted panels of many combinations and exposed them on the roof of one of their terminal buildings. These panels have been subjected to weather conditions since the first week in March, 1914. The management of the road has permitted photographs of these panels to be taken and has invited engineers from the railroad and other groups to make personal inspection, when the panels had been exposed 11 years and five months.

"The result of this time test bears a very close relation to the accelerated test of Dubois and it is one of the few instances where a time test of elaborate character has been linked with a preliminary accelerated test.

"The accelerated test of Dubois showed that every panel primed with pure red lead and finished with a black paint withstood the test less well than the companion panel where a special ready-mixed red lead was used as primer. The time test has developed the same relative showing, but in some cases the companion panels seemed to wear equally well for ten years before the difference in favor of the ready-mixed red lead panels became apparent. The searching nature of the accelerated test brought out differences in three or four days that in some instances were not disclosed in the time test until ten years had elapsed. In no instance has any contradiction in the final results been noted, except the slight difference in the panels containing 20 and 30 percent of kauri varnish."

Uncle Sam Extends Helium Production

THE final closing of a contract with the Amarillo Oil Company of Amarillo, Texas, which, it is thought, will greatly increase the available supply of helium, the rare non-inflammable gas required for the operation of dirigibles, is announced by the Bureau of Mines. Under the terms of the contract, the Bureau will undertake the extraction of the helium from natural gas from the company's leases on the Cliffside Structure in Potter County, Texas, at a new helium plant to be constructed by the government at Amarillo.

Rubber Paint

PAINT made of rubber, which when applied to a surface would give a film possessing the desirable properties of rubber, has been the aim of many "inventors," and even the subject of several patents. There are several reasons why the use of rubber hydrocarbon as such for paint has been impractical. Solutions of rubber in organic solvents, so-called "cements," are very viscous and it is necessary to use low concentrations. Dilute solutions—say 2 to 5 percent—are difficult to handle as far as brushing, spraying, dipping, et cetera, are concerned.

After a film has been deposited it is not satisfactory, owing to its tacky nature, until it is vulcanized. This could be made an air-curing process, but at least several days would be required. Small objects could be cured in heaters, as is now done with baking paints, but such a process would limit the use of the paint too closely. Even were it possible to obtain a smooth, even coat wherever desired, there would be difficulty in obtaining a proper cure, as frequently considerable trouble is encountered in vulcanizing films deposited from a cement.

Recently, there has been perfected in the laboratories of the Goodrich Rubber Company, a method of modifying the properties of rubber hydrocarbon by means of a change other than vulcanization. A series of products ranging from a tough, horny substance to a brittle, pulverizable material resembling shellac is made available by this treatment. The hydrocarbon is known as thermoprene, and its promising properties as a basis of paint are described by Harold Gray, of the Goodrich Rubber

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Chassis f.o.b. Detroit

YOU may now have all the performance advantages of 6-cylinder engine and 4-wheel brakes on any size or type of Graham Brothers Trucks.

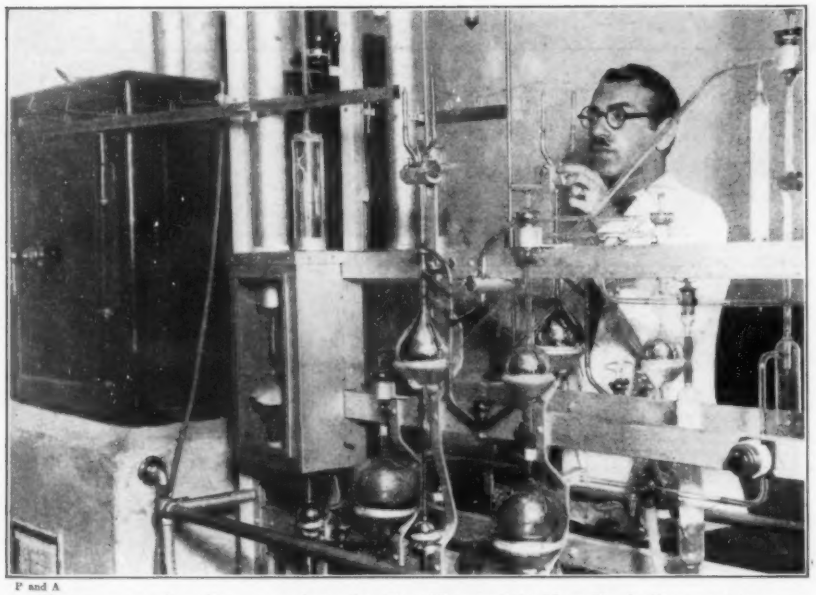
Six cylinder power . . . Six cylinder speed . . . Six cylinder operating ease . . . The snap of 6-cylinder acceleration and the safety of 4-wheel brake deceleration . . . Four speed transmission on all 1¼, 1¾ and 2½-ton models. See these trucks today. Let your local Dodge Brothers Dealer tell you of the many additional advanced features. We have the exact size and type for your business. Drive one. Compare them—for price, for value, for appearance, for their ability to do your job and make you money—with any truck you ever considered good value.

Graham Brothers Trucks are built in the chassis sizes that meet 95% of all hauling needs

GRAHAM BROTHERS TRUCKS

BUILT BY TRUCK DIVISION OF DODGE BROTHERS INC.

SOLD AND SERVICED BY DODGE BROTHERS DEALERS EVERYWHERE



P and A

Two grams of radium, used at the City Hospital in New York City, are kept in 40 glass tubes which are shielded by six inches of lead, and kept in the safe shown at the left. Photo also shows Dr. A. Norman, of the hospital staff

Company, writing in a recent issue of the publication of *Industrial and Engineering Chemistry*.

"The outstanding point of interest to the paint chemist," says Dr. Gray, "is that the concentration of thermoprene in the solvent can be as high as 10 to 20 percent and still be within the range of good brushing products. The chief difference between thermoprene paint and those previously made with a raw-rubber vehicle is that the former resembles a lacquer in that it needs no vulcanizing or curing operation.

"The resistance of the thermoprene paint to chemical action by acids, alkalies, corrosive gases and chemicals is very good. It shows a remarkably low permeability to moisture. Any paint to be of value must adhere firmly to the surface it covers. The high degree of adhesion of the new paint is one of its most important properties. It is practically impossible to separate the film from the underlying surface without actually cutting it.

"Another rather unusual feature of the paint is its resistance to sudden temperature changes. In one series of experiments the films (on steel) were cooled in an ice-salt bath and then put on a hot plate at 115 degrees, Centigrade. After 15 minutes on the hot plate the panels were plunged into the ice water again. This cycle was repeated 10 to 15 times with no apparent effect on the films.

Any desired pigment can be used in the paint and any color except a pure white can be obtained. The amount of pigment can be varied widely. The possible range extends from no pigment at all to as high as 250 to 300 volumes of pigment to 100 volumes of thermoprene. The practical range is yet to be determined. Good results are obtained with 70 volumes of pigment. Color may be imparted by organic dyes, using a white pigment as the filler. A very wide range of oils and softeners can be used. In some cases where a baking paint is desired, drying agents may be used.

"The paint should probably be classed as a lacquer, since a solvent is used which does not remain as a part of the film. In general, the ordinary rubber solvents are used—such as gasoline, toluene, benzene, carbon tetrachloride, turpentine, kerosene, et cetera. The solvents are varied according to the use for which the paint is intended—brushing, spraying or dipping."

Dirt by the Tablespoonful

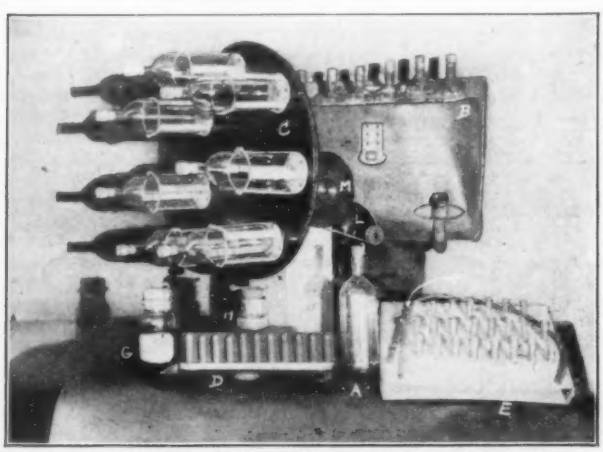
HOW much dirt do you take with your daily air? The answer varies with the location in which you pass your days, and despite its reputation as the "Smoky City," Pittsburgh, Pennsylvania, is not the home of the champion dust inhalers.

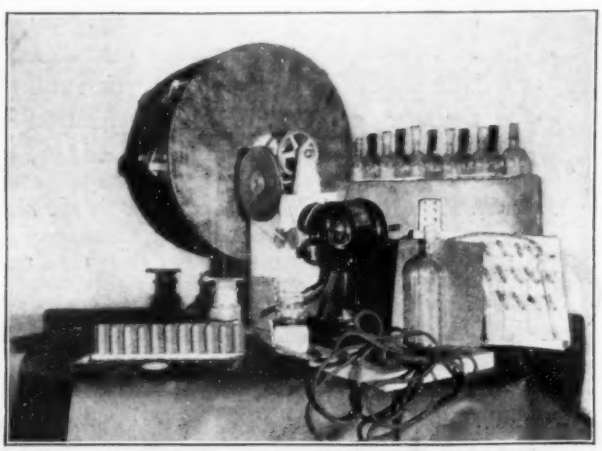
Howard C. Murphy recently told the American Society of Heating and Ventilating Engineers that St. Louis leads all of the cities of the country in smoke production, with Cincinnati a poor second, and Pittsburgh, the former unholy example, in third place. St. Louis is making a real attempt to cut its smoke. Schools have been established to show home owners and apartment house superintendents the proper method of firing the soft coal that is universally used in the city. It is estimated that proper firing of domestic furnaces and boilers will reduce the smoke by 80 percent. Pittsburgh has worked for several years and results are apparent when the "Smoky City" drops to third place on the list.

Mr. Murphy figures that the average St. Louisan inhales more than a tablespoonful of dirt every day, while the New Yorker takes a teaspoonful. His figures for the dust particles per cubic foot of air based on a test of several years' duration are as follows: St. Louis, 17,600; Cincinnati, 16,770; Pittsburgh, 16,100; Detroit, 15,300; Cleveland, 13,840; Louisville, 13,340; Buffalo, 12,350; Baltimore, 11,980; Milwaukee, 11,460; Toledo, 10,700; Columbus, 10,160; Philadelphia, 9880; New York, 9700; Kansas City, 9700; Atlanta, 9460; Minneapolis, 8470; Des Moines, 8370; Washington, 7800; Denver, 6740; New Orleans, 6600; San Francisco, 6580; Boston, 5360.

The *Gas Age Record* points out the lack of regulations controlling the purity of air in our cities, all of which carefully control food and water supplies. "This seems astonishing when one thinks of the important par the respiratory function plays in sustaining human life," says this magazine, editorially. "The summer death rate has been decreasing steadily, but the winter death rate is steadily increasing. Present knowledge points to air pollution as one of the contributing causes. Besides carrying germs, these smoke particles cause a foggy

(*Please turn to page* 173)





The photographs above and to the right show apparatus for determining the amount of carbon monoxide in the air. Samples of the air are collected in bottles and taken to the laboratory. Here, by means of the equilibrator shown, a blood reagent is exposed to the collected gas. Then the reagent is treated with a bleaching solution. The resulting color, compared with color charts, denotes the amount of carbon monoxide in the tested air

Have you tried the new Listerine Shaving Cream?

Cools your skin while you shave and keeps it cool afterward. An outstanding shaving cream in every respect.

Don't fool yourself

Since halitosis never announces itself to the victim, you simply cannot know when you have it.

The ring came back *-with a bottle!*

Today, halitosis is inexcusable
People who offend deserve no sympathy

A WOMAN we know took a direct means to settle a matter which she couldn't bring herself to talk about.

She returned the engagement ring—with a bottle. A bottle of Listerine. It carried its own implication.

Brutal? Perhaps. But those who today offend by halitosis (unpleasant breath) deserve not too much consideration. They ignore the facts about it (see below). They refuse to suspect themselves. They fool themselves.

Nice people, fastidious people, people who consider others, recognize the constant risk of offending this way, and keep themselves on the polite and popular side by using Listerine. Every morning. Every night. And between times when necessary—especially before meeting others.

Keep a bottle handy in home and office for this purpose.

Listerine ends halitosis instantly. Being antiseptic, it strikes at its commonest cause—fermentation in the oral cavity. Then, being a powerful deodorant, it destroys the odors themselves.

If you have any doubt of Listerine's deodorant properties, make this test: Rub a slice of onion on your hand. Then apply Listerine clear. Immediately, every trace of onion odor is gone. Even the odor of fish on the hands yields to it. Lambert Pharmacal Co., St. Louis, Mo.

READ THE FACTS
⅓ had halitosis

68 hairdressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?

LISTERINE
-the safe antiseptic

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Oil-Cooled Tubes

OIL-COOLED thermionic tubes used to generate the extra high-frequency oscillations are employed on the main circuits of the Marconi beam transmitters in preference to water-cooled tubes, because in short-wave work oil is easier to handle. Also, it is itself an insulator.

Underwood and Underwood

C. Francis Jenkins recently demonstrated his latest radio "movie" receiver in Washington, D. C., before the members of the Federal Radio Commission. The receiver, shown above, reflects the moving image by means of a mirror

Amateur Regulations

THE Federal Radio Commission has established the following regulations governing the licensing and operation of amateur radio stations:

"Amateur radio stations are authorized for communication only with similarly licensed stations and on wavelengths or frequencies within the following bands: 401,000 to 400,000 kilocycles (0.7477 to 0.7496 meters); 64,000 to 56,000 kilocycles (4.69 to 5.35 meters); 30,000 to 28,000 kilocycles (9.99 to 10.71 meters); 16,000 to 14,000 kilocycles (18.7 to 21.4 meters); 8000 to 7000 kilocycles (37.5 to 42.8 meters); 4000 to 3500 kilocycles (75 to 85.7 meters), and 2000 to 1500 kilocycles (150 to 200 meters).

"These stations may communicate at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8 and 10:30 P.M., local time, and on Sundays during local church services.

"Amateur radio telephone operation will be permitted only in the following bands: 64,000 to 56,000 kilocycles (4.69 to 5.35 meters); 3550 to 3500 kilocycles (84.5 to 85.7 meters), and 2000 to 1715 kilocycles (150 to 175 meters).

"Spark transmitters will not be authorized for amateur use.

"Amateur stations must use circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize key impacts, harmonics and plate supply modulations. Conductive coupling, even though loose, will not be permitted, but this restriction shall not apply against the employment of transmission line feeder systems to Hertzian antennae.

"Amateur stations are not permitted to communicate with commercial or Government stations, unless authorized by the licensing authority, except in an emergency or for testing purposes. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats holding limited commercial station licenses which may have difficulty in establishing communication with commercial or Government stations.

"Amateur stations are not authorized to broadcast news, music, lectures, sermons or any other form of entertainment.

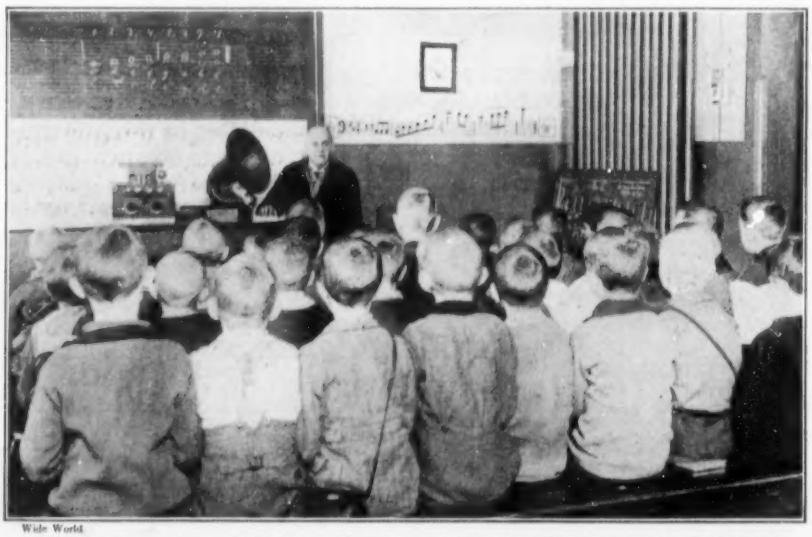
"No person shall operate an amateur station except under and in accordance with an operator's license issued to him by the Secretary of Commerce."

Tests Effects of Sunspots on Radio

FUTURE radio engineers may be able to look at the sun through a telescope and then tell how the presence or absence of spots will affect the transmission of radio waves, as a result of an investigation now under way with the co-operation of physicists and astronomers.

There has just been installed in the Harvard Astronomical Laboratory, under the direction of Dr. Harlan T. Stetson, professor of astronomy at Harvard, apparatus to study the relation of spots and radio. Greenleaf W. Pickard, Boston radio engineer, designed the apparatus, and installed it for use in connection with studies which he has been carrying on for several years. Each day the sun is photographed to give the size and number of spots.

"It is not yet possible to say whether or not a combination of radio data with observation of the sun can ever be used to predict earthly weather conditions," said Dr. Stetson. "However," he continued, "observations are beginning to make us feel confident that there is a direct connection between conditions in the solar atmosphere and certain atmospheric disturbances on



Wide World

These youngsters of the class of music at the Christburger School in Berlin are receiving their instruction by means of the radio receiving set shown

the earth. It seems not unlikely that with the further study of the bearing of sunspots upon radio reception it will be possible to make allowances for the solar disturbances and by so doing discover more closely than ever before the correlation of radio reception with temperature, pressure and other meteorological phenomena.

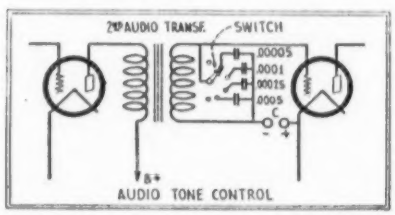
"Just what happens on the earth when a sunspot appears on the side of the sun towards us is not fully known. It is believed that electrified particles discharged from the disturbed region on the sun, hurling through space, bombard the upper atmosphere of the earth and are responsible for an increased ionization of the latter which is responsible for the modification of the intensity of the radio waves."

The station from which the signals will be sent, which are to be measured at the Harvard laboratory, is WBBM, Chicago. The apparatus which automatically records signal strength, as received in Cambridge, is carefully calibrated each day and makes it possible to record the measurement in absolute units of electrical intensity.

Dr. Stetson explained that the apparatus was so designed as to measure the intensity of the carrier wave and would scarcely be affected at all by super-imposed modulations caused by the broadcasting of music. —*Science Service.*

Tuning Audio Transformers

THERE never will be a universally ideal amplifier or loudspeaker, because all ears and musical tastes do not run alike. Some prefer an accentuated sharpness or crisp reproduction; others prefer a mellow, deep rendition. Others—and they are rare—strive for a happy medium. Fortunately, however, it is possible with the aid of small, inexpensive mica fixed condensers, to obtain almost any musical quality from the usual radio set.



Tone control with fixed condensers

Transformer coupling will usually give sharp, crisp reproduction. If that kind of reproduction is desirable, then the transformer-coupled amplifier should be left alone. Slight modification of "B" and "C" voltages may result in accentuating the sharp, crisp effect even more, if desired.

When it is preferable to adjust the sharpness or mellowness of radio rendition in accordance with the subject matter of the program, such as crisp reproduction for speech and mellow reproduction for orchestral selections, the arrangement shown in our sketch may be followed. This comprises a collection of condensers arranged in steps of capacity and shunted across the secondary of the second audio transformer.

For Television Experimenters

WITH the development and introduction of the Kino-Lamp or neon tube for television reception, and the Foto-Cell for television transmission, the Raytheon

. . . over the miles and years

THE history of Hyatt Quiet Roller Bearings . . . during the last 37 years . . . records years of unprecedented savings in attention and replacement.

Millions and millions of automobile miles reflect Hyatt's unparalleled operating stamina . . . uninterrupted performance . . . unwavering satisfaction!

As in the automobile, at various strategic points in industrial, railroad and farm equipment are Hyatt Roller Bearings . . . selected because of the silent, efficient manner in which they harmonize with the objectives of engineers.

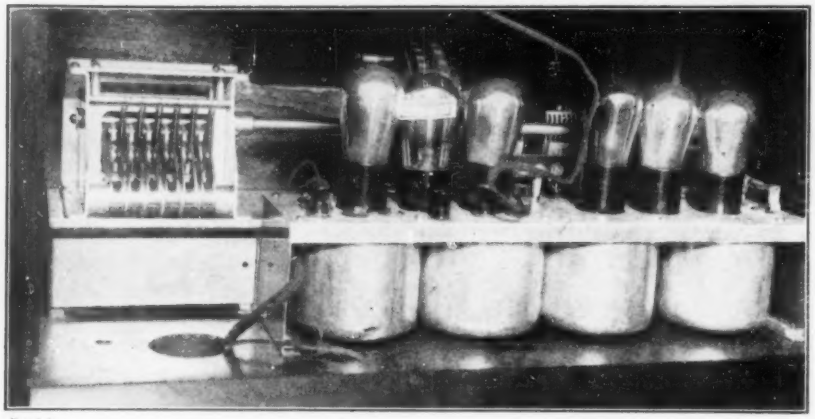
Selected, too, because of the faithfulness with which Hyatt quality preserves and protects the reputation of those products in which Hyatts are used.

HYATT ROLLER BEARING COMPANY

Newark Detroit Pittsburgh Chicago Oakland

HYATT
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



P and A

By means of this special radio receiver, programs from various broadcasting stations are received by the simple process of pressing the proper lever

organization has launched into an extensive campaign of research and special production in co-operation with television experimenters.

"We do not assume for a single moment that television has arrived at the commercial stage or anything even approaching such refinement," stated D. E. Replogle. "However, we do believe that the time is ripe for television experiments both at the transmitting and the receiving end, on an extensive scale. Therefore, as headquarters for gaseous tubes of all kinds, we are prepared to co-operate with experimenters and others in the development and production of special tubes for television requirements.

"Our research staff, headed by C. G. Smith, inventor of the Raytheon tube and its predecessor, the S-tube, has had long experience in gaseous conduction. Experiments have been conducted with every conceivable gas, electrode, spacing, arrangement, insulator and so on. We have studied the effects of gas pressure until today we can produce tubes of a given starting voltage, luminosity, responsiveness, and so on.

"We therefore wish to co-operate with television experimenters in the development of the necessary neon tubes and photo-electric cells of regular or special design, to the end that this young art may receive the maximum co-operative effort of amateurs in repeating the spectacular development of radio broadcasting."

DX Still With Us

THE DX "hound" has not disappeared by any means, in the opinion of Hal P. Shearer, general manager of Splitdorf Radio Corporation.

Upon returning to Newark, New Jersey, from a several weeks' tour of the mid-west and far west, Mr. Shearer stated that he is inclined to the belief that the distance-loving fan is "even worse than ever." He quickly explained that he did not mean to hold this against the radio-set owner who loved to sit up nights and tune in the far-distant stations. On the contrary, he believes this to be a good thing, adding, "for those manufacturers whose sets are capable of picking up distant stations with any regularity."

"On the west coast," said Mr. Shearer, "a set must be good to satisfy most of the fans. Even with the chain broadcasting of today it is necessary for the west-coast people to reach out for distance to satisfy themselves entirely, and I do not intend this as a criticism of west-coast programs. The feeling is still there for the getting of a station some 2000 miles away. There is no question about it—so far as DX is concerned we are just as much interested in it today as we were in the years-ago of radio. Of course, there is quality with distance now on a good set, but the lure is the same old lure—thank goodness for that!"

P and A

Commander E. F. McDonald, noted explorer, demonstrating the automatic radio receiver which he has designed. There are no dials in the ordinary sense of the word, tuning being accomplished by the switches

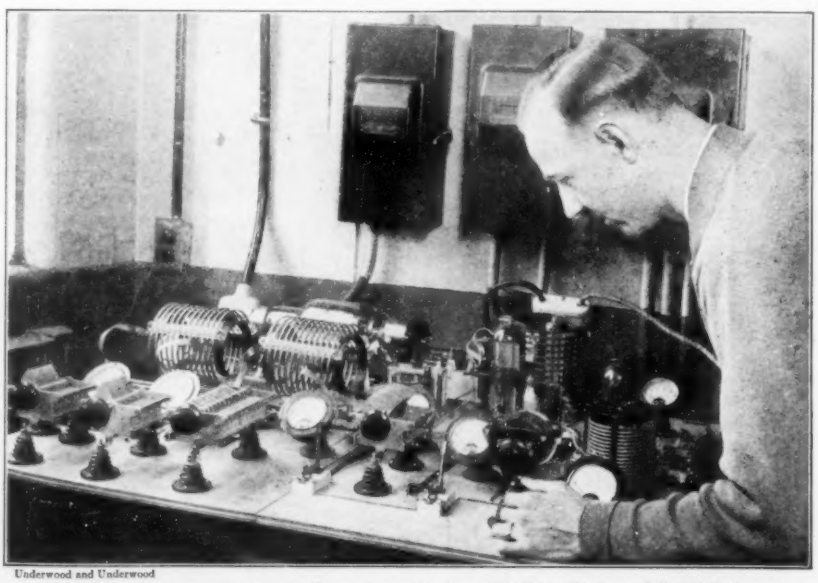
Soundproof Room for Testing Radio Receivers

IN testing the quality of radio reproduction, absolute quiet must prevail, a condition which is difficult to obtain in the modern factory. To this end Frank A. D. Andrea built for his engineers a soundproof room of unique design. This room is in reality a room within a room. It has double walls, double ceiling and a double floor. The space between is filled with wood chips. The room is supported on cork to remove the vibration of the building. The inner door is suggestive of the entrance to a refrigerator.

The soundproof room has among its equipment oscillators, amplifiers, radio receivers and measuring equipment of several kinds. It is easily apparent that in a soundproof room of this sort development work progresses to advantage in all phases of radio research requiring the most delicate measurements and testing for absolute quality.

Increasing Efficiency

MANY radio owners run their receivers like a good many automobile owners run their cars—at very low efficiency. Running a car at very low efficiency is often inexcusable because in most cases the trouble lies in the fact that minor adjustments have been neglected. An improperly adjusted carburetor or poorly seated valves will cause considerable loss of power and the formation of carbon which will soon further decrease the efficiency of the motor. In most cases a simple adjustment which could be made in a few minutes at very little cost would increase the efficiency tre-



Underwood and Underwood

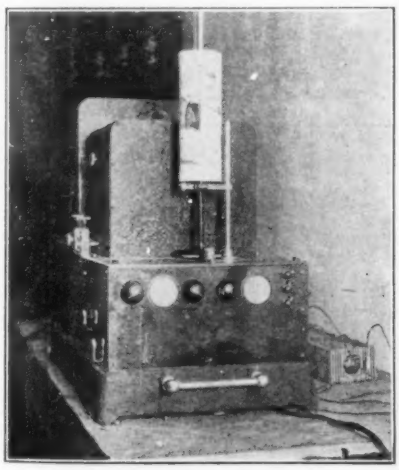
The new short-wave transmitter installed at WABC, Richmond Hill, Long Island. William Schick is shown tuning the set to its wavelength of 58.5 meters

mendously, result in a great saving of gas and reduce the necessity of repair bills.

In radio amplification it has been common practice to use a "B" or plate voltage of 90 volts without a biasing battery, and while this results in maximum amplification, it is wasteful of battery current and tone quality. A decrease of this voltage to 67.5 or even 45 volts, or the addition of a "C" battery in the radio-frequency stages will result in a large saving of "B" battery current, together with improved tone quality on local stations. Two CX-301A

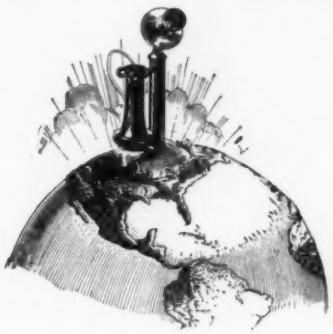
Herbert

Above and below are two views of the transmitter for photographs that was invented by Austin G. Cooley of New York. The system is said to be very simple in principle, and it has been announced that kits for constructing adapters for receiving the pictures on broadcast sets will soon be available



tubes as radio-frequency amplifiers require 12 milliamperes plate current with 90 volts "B" voltage, 7 milliamperes with 67.5 volts and only 3.4 milliamperes when the voltage is reduced to 45 volts. The use of lower plate voltages will often more than double the service obtained from dry cell "B" batteries, and will result in securing quiet, hum-free performance from "B" eliminators, especially those having limited output.

Another distinct advantage of the lower "B" voltages for radio-frequency stages is the fact that oscillation is much easier to control, thus resulting in more stable operation of the receiver and better tone quality.



YOUR TELEPHONE, PRODUCT OF 28 COUNTRIES

SILK worms are busy in far-off Japan. Native Malayans are burrowing into tin-laden hills "east of Suez." High upon the Andes, the descendents of the Incas are digging for copper. *All to help make your telephone!*

To the Western Electric factories come raw materials from the far corners of the earth as well as from "just around the corner." Out of nineteen of the world's distinctly different products, American ingenuity has shaped the telephone.

But, if it takes a world of material things to make your telephone, think of the worlds of other things that play no little part.

The skill of the magnet coil winder. The dexterity of the sure-handed punch-press operator. The expertness of the keen-eyed laboratory worker. The guiding mind of the engineer. The vision of the manufacturing executive.

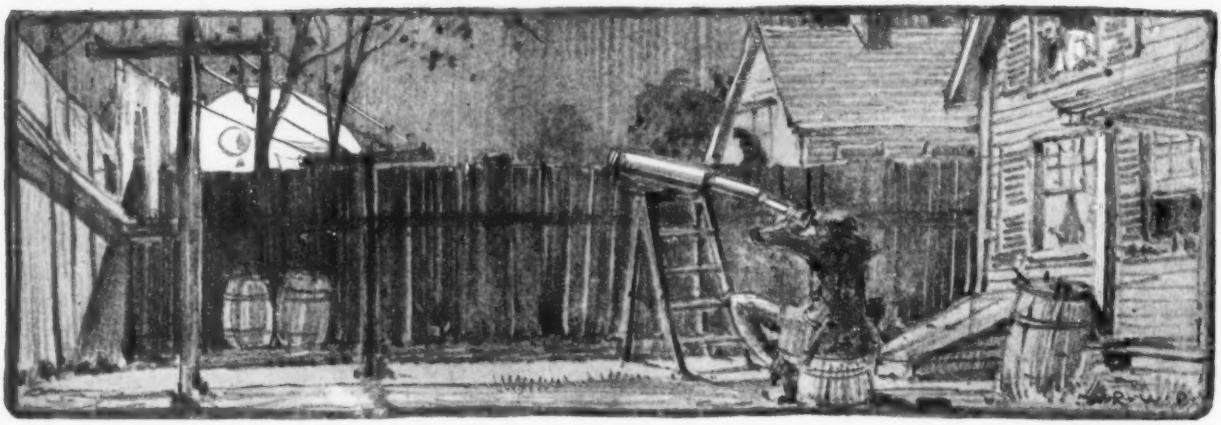
Of all these your telephone is made.

Over 500 different occupations are represented in the great army of Western Electric workers; an army which—while it directly carries on the triple responsibility of purchasing, manufacturing and distributing for the Bell System—indirectly "carries on" for you.

Western Electric

Purchasers... Manufacturers.. Distributors

SINCE 1882 FOR THE BELL SYSTEM



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

"A TELESCOPE ought to have a sufficiently rigid mounting," writes an amateur in Los Angeles, "so that it will not vibrate when a trolley car crosses a bridge in San Francisco." Well said. We have

Mr. Towson's telescope—rigid

seen a number of flimsy mountings which can not possibly be held steady. Sheldon K. Towson, 16215 Fernway Road, Shaker Heights, Cleveland, Ohio, sends in a description of his telescope which has what we call a sufficiently rigid mounting.

"The enclosed photograph," Mr. Towson writes, "shows a mounting which I believe is as simple an affair as it is possible to assemble, requiring machine work only for four bushings and the two axes. The base, pillar and 45-degree 'Y' branch are now permanently mounted on a concrete foundation. The rest of the mounting is temporary and will be replaced by a Ford axle rigging.

"The six-inch mirror, being my first attempt, has many faults; it is scratched, the parabola is questionable, and the silver does not reach the edge, but it is good enough to separate the components of *Epsilon Lyrae* and therefore serves to prevent undue haste while I polish an eight-inch mirror for the same mounting."

One of the most elaborate telescopes thus far made from the instructions contained in "Amateur Telescope Making," is the product of J. A. Johnson, Opt. D., 322 Patterson Building, Fresno, California. The description, sent in by the maker, runs as follows:

"I am enclosing some pictures of a 10-inch telescope which I have just completed. It is equipped with a clock and setting wheels, with lights over the circles to read

Dr. Johnson's elaborate arrangement

at night. I made patterns and had all the parts cast. The tube is 12 inches in diameter and six feet, six inches long. The mirror is 72-inch focus.

"The gears of the clock are standard stock. After making four different governors, I finally got one that is sensitive enough and it works perfectly. It took me 1800 hours to make it. I worked every night from 7 P.M. until 11 P.M. Telescope making is some hobby.

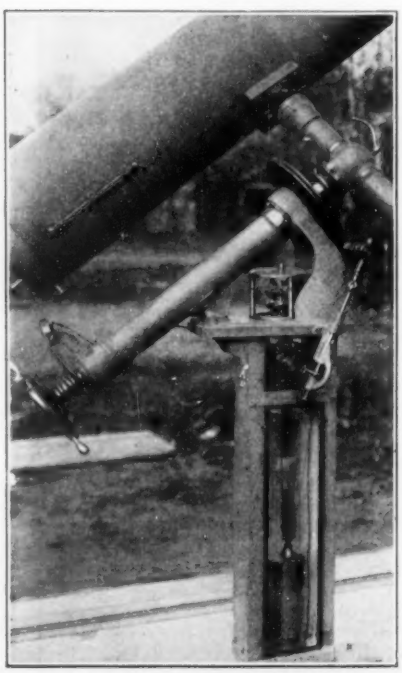
"The telescope house is 8 by 8 feet and 8 feet high to the plate. The telescope rests on a concrete base with a concrete floor nine feet square. The house is mounted on four small flange wheels which run on a light iron rail track.

"Your book on telescope making was a big help."

Some months ago we stated that a club of amateur telescope makers was being organized in Chicago. Thus far, however, no very tangible results have been reported from Chicago, but Philadelphia has now beaten Chicago to it. The following letter from Glenden J. Dunlap reaches us on the letter head of the local Y.M.C.A.:

"A club has recently been organized at the Central Y.M.C.A., for the purpose of giving instruction in the making of telescopes and in astronomy. The man in charge is Mr. G. H. Lutz, a civil engineer who made the world's first permanent tele-

(*Please turn to page* 176)



Detail of the axes and clock

Industries From Atoms

(*Continued from page* 166)

condition, technically known as "smog," that is making many of our cities rival London. Many students of air pollution believed at one time that factory stacks were the primary cause of smoky conditions and air pollution. Experience has shown, however, that it is the improper combustion in domestic heating plants that causes the major part of the smoke. There are thousands of these to every one factory stack."

Protective Coatings For Food Containers

IN order to prevent the loss of color of certain canned fruits, the so-called enameled cans (or lacquered cans as they are sometimes termed) have been developed. This enamel prevents the general corrosion of the inside of the can, says a bulletin of the National Canners Association, but the lacquer is not entirely continuous and cans so treated perforate to a greater extent than plain ones. Enameled cans have been used to an increasing extent for more than 15 years, not only with red fruits, but also with some of the more acid vegetables that have a pronounced flavor of their own, such as beets, and pumpkin. The enamel used for these products cannot be used with certain vegetables that have a more delicate flavor, such as asparagus and string beans, because it imparts an objectionable flavor to the product.

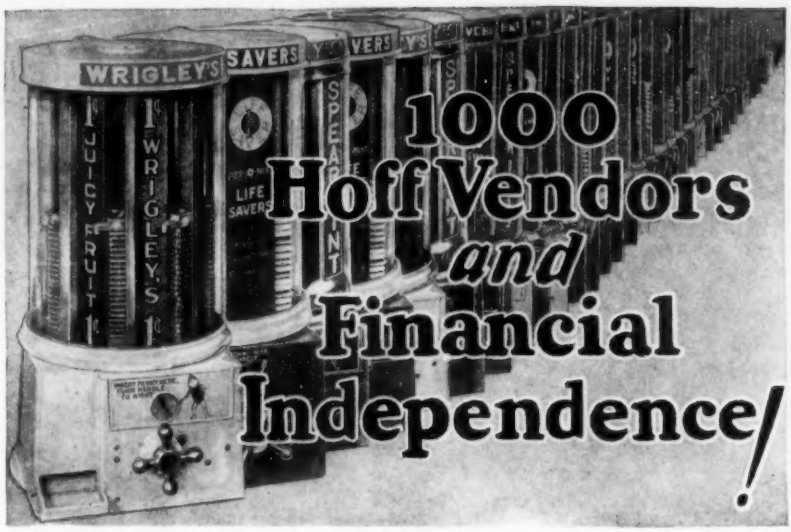
A special lacquer has been developed for products that have a tendency to form iron sulfide discoloration, especially corn. This special lacquer will not answer for acid products such as fruits, but has been found to prevent the iron sulfide discoloration for which it was developed and also to prevent the general tarnish to the inside of a can due to the formation of tin sulfide.

Chemists believe that the universal adoption of the lacquered can will follow upon the development of an entirely suitable lacquer. Recent experiments indicate that such a substance may become available from the development of synthetic resin lacquers. Excellent adhesive powers, extreme impenetrability and failure to impart taste or odor to foods are claimed for some of these new products of chemical synthesis now in the experimental stage.

New Sulfuric Acid Catalyst

THE use of platinum as a catalyst for the oxidation of sulfur dioxide gas to sulfur trioxide for the manufacture of sulfuric acid by the contact process is one of the commonest of industrial applications of catalysis. The precious metal is spread in a very finely divided state on the surface of asbestos fibers or small lumps of fused magnesium sulfate. It is entirely satisfactory as a catalyst, the conversion of sulfur dioxide to trioxide running from 95 to 99 percent, the platinum being unchanged except when "poisoned" by impurities in the gas. While no platinum is used up in the process, the quantity required for a commercial unit is large enough to represent a considerable investment, which must, of course, be charged against the cost of the acid.

Therefore, the acid manufacturer is intensely interested in recent developments



AN UNUSUAL BUSINESS OPPORTUNITY

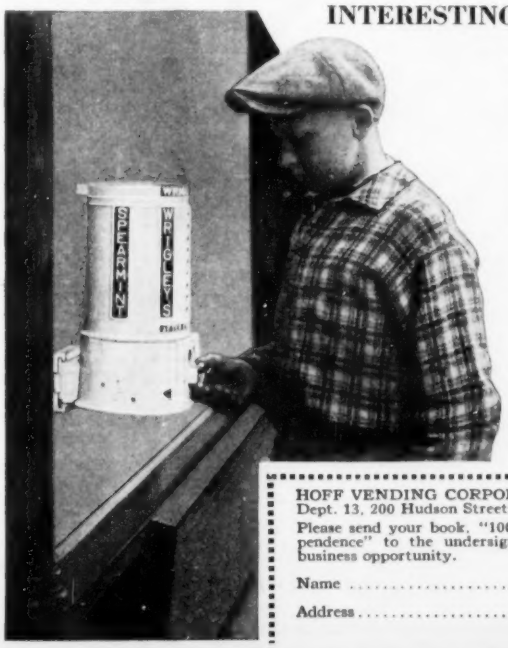
THE owner of a chain of vending machines is an independent business man whose duties are easy and pleasant, and who makes permanently, month after month and year after year, extremely high profits on a nominal investment. This statement is based on the experiences of more than 70 chain operators of Hoff Vending Machines, more than 30,000 of which are now in operation.

ENORMOUS DEMAND

The Hoff Vending Corporation of America, a division of a fifteen million dollar corporation, controls the exclusive franchise for distributing in penny vending machines two of the world's largest selling, best advertised, and most popular confections—a famous gum and a famous candy. Because of their enormous demand, monthly sales by Hoff vendors are large and steady. This demand is annually maintained and increased by enormous sums spent in advertising—during 1928 alone, more than $7,500,000.

HIGH EARNINGS

Practical chains, consisting of from 200 to 1000 vendors, which can be easily serviced by one man or woman, show net earnings of from $2,820.00 to $13,800.00 yearly. No special experience or training is required. There is little to learn. Operating expenses are practically nil. The business can be run right from one's own home. The work is easy and pleasant, and most of it out of doors.



INTERESTING BOOKLET

Full details concerning the Hoff system of Penny Vending, including earnings of vendors, franchise details, cost of machines, cost of gum and candy, and the experiences of established operators, are gladly furnished on request. Write today for our new book "1000 Hoff Vendors and Financial Independence." It gives all the facts you need to know. Write today.

HOFF VENDING CORPORATION OF AMERICA

Division of General Vending Corporation

Dept. 13, 200 Hudson St., New York City

Hoff Vendors awarded gold medal, Sesqui Centennial Exposition, Philadelphia, 1926.

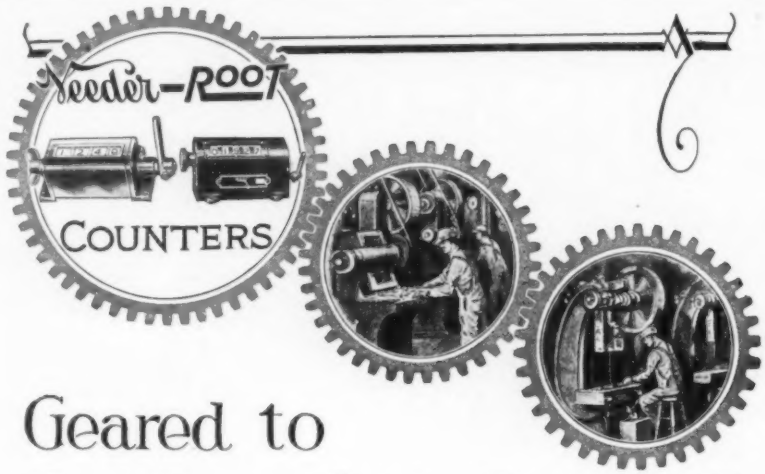
HOFF VENDING CORPORATION OF AMERICA,
Dept. 13, 200 Hudson Street, New York, N. Y.

Please send your book, "1000 Hoff Vendors and Financial Independence" to the undersigned. I am looking for an unusual business opportunity.

Name .....

Address .....

.....



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The pace that pays—in machine operation—is a little faster than "routine." Set it at a standard rate and keep it up by *checking-up* with Counters. Step it up to a *higher* mark, as you develop a better machine or a better operator. Make the improvements *register* on a VEEDER-ROOT Counter.

Below is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero from any figure by turning knob. Price, $6.00. With lock and key to prevent tampering with record, $2.00 extra. Also furnished in a Revolution Counter. Write for our *green book* of Counters for all machines.

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which have brought the announcement of a satisfactory substitute for platinum which can be made at a much lower investment. A catalyst developed by the Monsanto Chemical Works, St. Louis, Missouri, is described by Dr. L. F. Nickell in a recent issue of *Chemical and Metallurgical Engineering*.

"Essentially," said Dr. Nickell, "these new catalysts consist of complex vanadium silicates and give compact masses of high catalytic activity. The complex vanadium silicates can be used as such, or they can be diluted with various inert substances of any particular size. In either case, they exhibit an exceptionally high activity, showing conversions of SO_2 to SO_3 of 97 percent to 98 percent and even above, which conversions are maintained at usual commercial loading rates. The mass will even stand a large overloading.

"Aside from greatly decreased cost as compared to platinum catalysts, the great advantage of these new catalysts in sulfuric-acid manufacture, lies in the fact that they are not poisoned by such substances as arsenic or hydrochloric acid, which impurities are frequently encountered in commercial sulfur dioxide gases, especially those from metallurgical roasters.

"In the case of a platinum mass, the usual experience is that such poisons result in a gradual but continuous decrease in activity, with consequent increase in the manufacturing cost in sulfuric acid. The advantage of a contact catalyst which is not affected by such poisons, and which constantly gives a high conversion, is obvious; and such has been our experience with these new catalysts over extended periods of time.

"With the exception of this marked advantage, the behavior of these new catalysts with respect to temperature, conversion equilibrium and activity, closely parallels that of the best platinum catalysts. It is believed that within the next decade the use of platinum catalysts for sulfuric acid will be entirely abandoned and the use of vanadium catalysts completely established in their stead."

Water Preferred

CHEMISTRY is credited with a world-wide trend toward prohibition by no less an authority than Dr. William J. Mayo, one of the justly famous Mayo brothers of Rochester, Minnesota. Speaking before the American Chemical Society recently, Dr. Mayo stated his belief that neither prohibition propaganda nor an appeal to the conscience of man has caused the rapid advance of the temperance movement, but that pure water, made available by the application of chemical, bacteriological and engineering knowledge, has made this possible.

"It is assumed that the drinking of spirituous and fermented liquors is due to an evil inborn longing, to be stamped out only by the exercise of individual self-control. Is this true?" asks Dr. Mayo. "In France and Italy the drinking of billions of gallons of wine saved the people from extinction; they could not have lived had they drunk their polluted water. The Teutonic countries turned to beer to secure a sterile drink; England had ale and wine; and temperance countries, such as Turkey, had tea and coffee. Simultaneously with Vienna's introduction of a pure water supply from the mountains, her per

capita consumption of spirituous and fermented liquor was reduced spontaneously 40 percent. The introduction of a pure water supply in the various states in our country has been followed by a temperance movement, and finally by prohibition.

"The same influence is now apparent in Europe. In England pure water is to be had in the large cities, and a temperance movement promptly results, but in the villages without potable water no such movement is as yet manifest. The drink habit was one of the many forms of protection resorted to by Nature to save man from filth diseases which cause death, or that which is worse than death, intellectual deterioration. Prohibition outlawry is largely from the alien who comes from countries where water could not be used for drinking purposes and also, of course, from the dregs and froth of our own citizens."

Corrosion From the Hands

MANUFACTURERS of highly polished steel products such as mathematical instruments, piston rings, et cetera, have for years been annoyed with epidemics of corrosion without any apparent explainable cause. Every possible precaution has been taken to see that the metal was properly "slushed" with the best rust preventive, so that corrosion from atmospheric moisture or other external causes was seemingly impractical, and the parts were so treated as to obviate practically all probability of corrosion from causes "within," meaning the sweating of the metal beneath the rust preventive film, and yet corrosion would occur, not generally, but occasionally and somewhat mysteriously.

The following key to this puzzling problem and a method of solution is reported in *Black and White*, the organ of Houghton and Company, of Philadelphia.

"Quite a number of years back this problem was put up to the Houghton Research Staff by a prominent cutlery manufacturer and the solution of the problem was effected by the process of segregation and elimination. That is to say, every detail of each piece was tabulated, including the operatives handling each. It was discovered that this corrosion occurred more upon pieces handled by some than by others, and immediately it was concluded that some operatives were more careless than others. But a most careful surveillance of the conditions failed to detect such carelessness.

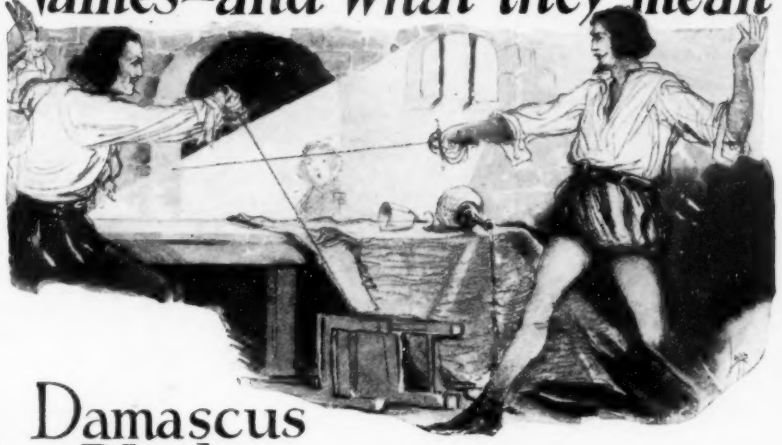
"Then the thought occurred that perhaps the corrosion was due to the corrosive influences of the acids from the perspiration. Accordingly the perspiration coming from those operatives whose work showed the least corrosion was examined and compared with those that caused the most and invariably the analyses showed excessive acid content in the latter.

"A prominent manufacturer of high-grade piston rings went through practically the same experience as the cutlery manufacturer and effected a remedy in the following and very unique manner. After ascertaining that the neutralizing of the acids on the operatives' hands with alkaline solution was not practical owing to the injury to the skin, they reasoned thus:

"If the rust preventive which we use to prevent corrosion after the rings are finished contains an inhibitor which neutralizes corrosive influences from within, why would it not be practical to apply that rust preven-

(*Please turn to page* 181)

Names—and what they mean



Damascus Blades

In those days a man's life was very often worth no more than the quality of steel in his sword. Out of the Orient came a steel that was called Damask. Blades made of it proved themselves in the hands of the greatest swordsmen to be of wonderful strength, keenness and temper.

In time these splendid swords became known as Damascus blades and the name came to stand for superlative qualities; qualities that meant so much to a man when all that stood between him and sudden extinction was a strip of steel half an inch wide.

So great was the excellence of these swords that to this day the best Damascus blades remain some of the greatest examples of the swordmakers craft.

In different fields and times the name

Tycos

has earned the title "Industry's Sixth Sense."

TYCOS is the symbol of an extensive line of temperature instruments that go far beyond the greatest possibilities of the five senses. In the industrial fields they enable manufacturers in a thousand varied industries to know, to record and to control temperatures. They do this in uncounted processes where such knowledge, control and records are absolutely essential to success.

Manufacturers having to use correct temperatures in their undertakings will find TYCOS engineers always ready and willing to help solve problems of this nature, usual or unusual. They will find TYCOS instruments accurate, reliable and capable, worthily earning their present reputation as INDUSTRY'S SIXTH SENSE.

Names usually begin by being merely a label or tag by which to identify things. Some names acquire through the years and as a result of outstanding merit in the product itself, a deeper significance. Such names become a sort of measure for excellence, a standard by which to judge similar products or things.

Many years ago the name TYCOS was chosen as the symbol of a line of temperature instruments. Beginning with the ideal of making the most complete as well as the most reliable and accurate temperature instruments possible, the makers by strict adherence to this ideal through years of experimentation and research have produced a remarkable line of instruments. Successfully meeting all kinds of temperature problems has resulted in TYCOS becoming known everywhere as the mark of excellence in temperature instruments.

There are TYCOS instruments for all needs. Besides the great variety of industrial instruments there are household and medical instruments. For the home there are outdoor and indoor thermometers, oven, bath and candy thermometers. For the foretelling of weather there is the Stormoguide.

There are fever thermometers and sphygmomanometers. In fact, in the following list we can only give a suggestion of the many instruments bearing the name TYCOS and their uses.

All these instruments can be bought at your dealers or we shall be glad to send them direct if he does not carry them. Write for literature on the type of instrument that interests you.

Tycos Temperature Instruments
INDICATING - RECORDING - CONTROLLING

Office Thermometers
An aid in promoting human efficiency.

Bath Thermometers
To enable you to get the most good from your bath.

Home Sets
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Quality Compasses
To show you the right way in unfamiliar country.

Fever Thermometers
A necessity in every home.

Stormoguides
Forecast the weather twenty-four hours ahead with dependable accuracy.

Hygrometers
To enable you to keep the humidity of the atmosphere in your home correct at all times.

FOR THE MEDICAL PROFESSION

Sphygmomanometers, Pocket, Office and Recording types. Urinalysis Glassware. Fever Thermometers.

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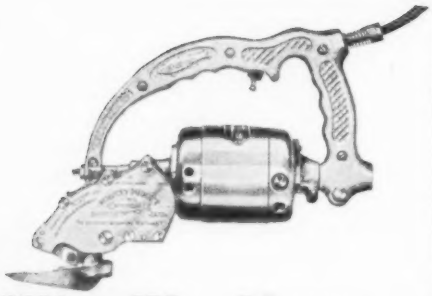


Why We Chose the Dumore Motor

"We have been frequently asked why we use Dumore Motors in our Mighty Midget Unishear. We use them because—

We have long been familiar with the satisfactory performance of Dumore Motors.

In developing our Mighty Midget Unishear we found a highly satisfactory cooperation on the part of the Wisconsin Electric Company in furnishing us with a motor suitable for our requirements.

Out of over two thousand Dumore Motors *now in* heavy service *on our Mighty Midgets Unishears, we have experienced practically no difficulties and wherever we did have trouble it* could always be traced to neglect on the part of the user."

THE UNISHEAR COMPANY, Inc.
G. A. Unger, Consulting Engineer

THE Mighty Midget Unishear has taken an important place in metal cutting work, filling a long felt need for a portable, power driven machine that combines accuracy, speed and easy operating features.

Manufacturers of motor driven appliances will find several outstanding advantages in Dumore motors. Every motor is dynamically balanced—a process carried out on a special machine of our own design. Vibration caused by unbalanced weight is eliminated. The bearings are protected, the dynamically balanced motor runs without noise, it uses less current and operates efficiently much longer than a motor not in dynamic balance.

This special feature of Dumore motors is backed by proven construction methods, special insulation, extreme accuracy of all parts and close inspection of every operation. The resulting superior quality has been placed on a production basis, giving you the advantages of outstanding performance at no increase in price.

Let our engineering department explain the advantages of dynamic balance in the motor, applied to your machines. Write.

DUMORE
TRADE MARK—REG. U. S. PAT. OFF.

Dynamically Balanced Universal Motor

WISCONSIN ELECTRIC CO.,
48 Sixteenth St., Racine, Wis.

The Back Yard Astronomer

(*Continued from page* 172)

scope mirror (stellite) which is now on exhibition in the American Museum of Natural History, New York.

"The organization is called 'The "Y" Telescope Club' and meets at 7:30, every Thursday evening, in Room 121, 1421 Arch Street. It is open to young men of high school age and over.

A list of those in Philadelphia who have evinced an interest in amateur work of this kind by purchasing copies of "Amateur Telescope Making" is being sent the club.

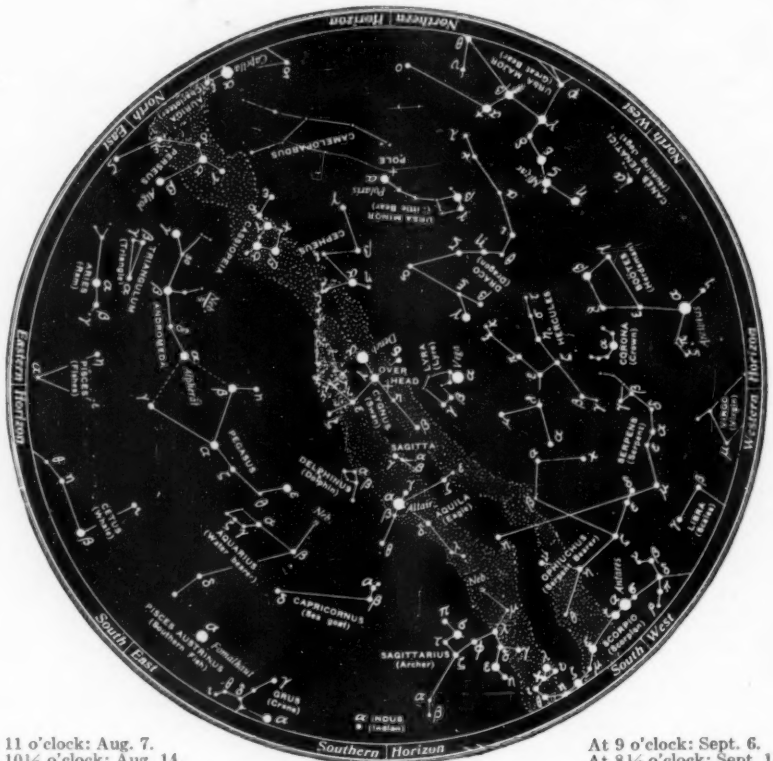
Finally, may we recite a joke, taken from the *Wright Engine Builder*, a house organ? It seems that two darkies who were discussing the relative merits of the sun and the moon said:

"De sun am de bes'; dey cain't be no doubt about dat," said Sam. "Look at how much mo' light she give dan de moon. You ain't tryin' to convince me dat de daylight ain't brighter dan de moonlight, is you?"

"Dat's all right about de sun givin' de mos' light," replied Joe, "but you is got to remember dat de moon deserves de mos' credit because de light she gives come at night when it would oderwise be dark, while de sun shine in the day time when it am light anyhow."

The Heavens in August

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

MERCURY is an evening star until the 16th when he comes between us and the Sun, although not exactly in line, and begins to figure as a morning star. He can be seen only at the beginning and end of the month, if at all.

Venus is now an evening star but is still pretty near the Sun, and even at the end of the month she sets only a few minutes after seven o'clock.

Mars is in Taurus, approaching quadrature, and is steadily coming nearer and growing brighter. By the middle of the month he rises at 11 P.M.

Jupiter is in Aries and rises nearly two hours earlier than Mars. Last month the two were close together, but Mars has moved eastward while Jupiter has stood nearly still in the sky.

Saturn is in Scorpio and is due south in the early evening about 7 P.M.

Uranus transits about 2 A.M. and is observable in the morning.

Neptune is in conjunction with the Sun on the 22nd and is unobservable.

The Moon is full at 10:30 A.M. on the 1st; in her last quarter at 12:24 P.M. on the 8th; new at 8:49 A.M. on the 15th; in her last quarter at 3 A.M. on the 23rd; and full again at 9:34 P.M. on the 30th (all these times as usual are Eastern Standard, not daylight saving time). She is nearest the Earth on the 10th and farthest off on the 23rd, and as she swings around the sky she passes Uranus on the 5th, Jupiter on the 8th, Mars on the 9th, Mercury on the 15th and Neptune a few hours later the same day, Venus on the 16th and Saturn on the 24th. The conjunction with Mars is close and an occultation is visible in Asia.

The Scientific American Digest

(*Continued from page* 159)

over three sixteenths of an inch high, and is seven thirty-seconds of an inch long from one end of the shaft to the other. The frame and the armature are of iron, and the base, under which the wires are run in grooves, is of solid brass. It has two field poles, each coil of which is wound with 35 turns of number 36 varnished copper wire; and four armature poles, each coil of which is wound with 20 turns of number 40 varnished copper wire.

The armature is slightly under one eighth of an inch in diameter, and the commutator is approximately half of that. The commutator has four segments, and the brushes, which are adjustable, are of gold. The shaft is less than one sixty-fourth of an inch in diameter. Tiny watch screws were used to hold together the parts, of which Mr. Gomez says there are a total of 48 in the motor. A small flashlight cell supplies the power to run it.

Not content with making the motor, Mr. Gomez proceeded to make an elevator mechanism to be run worm-screw fashion by it. This mechanism is one and one eighth inches high. It has a steel drum five sixteenths of an inch in diameter and three sixteenths of an inch wide with side flanges one sixteenth of an inch high.

Mr. Gomez did not tell us how soon he expects to take his trip to Spain.

Lindbergh Beacon Turned On

THE Lindbergh Beacon, an 8,000,000-candlepower airport light, built by the General Electric Company and erected atop the City Hall tower in Los Angeles, was

The Lindbergh beacon, Los Angeles

officially turned on recently by President Coolidge by the touch of a button in the White House at Washington. The light is in the nature of a monument to Colonel Lindbergh, presented to him by the people of Los Angeles.

The beacon is lighted by a 900-watt filament lamp, burning before a 24-inch mirror, the beams pouring through a 24-inch lens. The reflecting mirror is so designed as to throw a concentrated beam of light that can be seen a distance of 60 miles in fair weather. The beacon will revolve six times in a minute.

According to a report from Los Angeles,

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The Mark of Quality

Firestone

Gum-Dipped Heavy Duty Pneumatics hold all World Records for—

SAFETY—DURABILITY—MILEAGE

As a result of Firestone's own improved processes of manufacture, and the scientific engineering of definite types and sizes of tires to fully serve specific purpose, new records—records unheard of a few years ago—are being piled up by thousands of truck owners and operators. Whatever the hauling job, Firestone has built a tire to give the most economical and satisfactory service. The FACTS are before every tire buyer—the element of gamble has been eliminated. When you buy Firestone Tires, you KNOW that you are buying

MOST MILES PER DOLLAR

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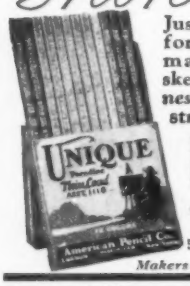

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Rises from ground and flies 75 ft. or more by own power. Entire model finished in BRILLIANT SILVER LUSTRE. Scientifically designed to last detail. Even the "Lone Eagle" himself at the controls! Very educational! Decidedly realistic! Sensational performer! Thrilling fun as it zooms away through the air, banking, turning, soaring before gliding to earth. Easy construction set, put together in evening without tools, complete materials including six inch propeller, adjustable wings, full directions, postpaid U.S. $1.00. Canada $1.25. Satisfaction guaranteed or return outfit in five days and receive money back. Be the first to own one. Order yours NOW!

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Be an electrical specialist. Gain quick success in this most fascinating and profitable field. Learn at National in the center of tremendous electrical projects costing more than $100,000,000.00—unlimited opportunities now.

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FREE BOOK

NATIONAL ELECTRICAL SCHOOL
Dept. 100C, 4006 So. Figueroa, LOS ANGELES, CAL.

the tremendous concentrating power of the reflecting mirror was noted when the workmen were installing and adjusting the beacon on the tower. The sunlight, caught by the mirror and reflected, fell upon the workmen and burned the hair off their arms in an instant. They were forced to turn the mirror to the north, away from the sun.

Another interesting feature of the beacon is that there are two lamps in it. They both rest on the same base, which is pivoted, the working lamp being at the focal point. Should this lamp burn out during the night the base carrying the two lamps will trip the new lamp into focus automatically and light it. This feature is necessary particularly where the beacons, which are standard government lights used on the national airways, are placed in out-of-the-way places and are visited only once a month by caretakers. On such lights, when the first lamp burns out and the new one swings into place, there is a red light on top of the beacon which also is lighted, informing the passing aviator that the first lamp is burned out and that the emergency lamp is burning.

German Process Separates Oil

A PROCESS for getting oil out of steam condensation water has been developed by Fritz Hoyer, a German scientist. It is expected to replace the mechanical methods for removing the troublesome residue of oil now in use.

Most of the oil which is used for lubricating steam pistons and gearing is atomized and carried away in the waste steam. As a result of this, a very stable milky emulsion is formed on the condensed water, and the problem of separation of oil and water is an extremely difficult one. Many mechanical oil separators have been tried, but up to the present they have not been an unqualified success, and when the condensed water which has passed through them is used for the boiler, appreciable quantities of oil also pass in. This oil combines with the boiler scale to form a solid mass which settles on the walls of the boilers and tends to cause overheating of the plates.

In the Hoyer process a direct current is passed through the water, which collects the oil in small foam flakes, thus destroying the emulsion and making filtration possible. The consumption of electricity is about one kilowatt hour for five cubic meters of water.—*Science Service.*

New Device Locates Source of Machinery Knocks

THE usual method of detecting and locating blade rubbing in steam turbines, loose pistons, cross-head and main-bearing knocks in steam engines, and similar troubles in power-plant machinery, is by means of a pencil, rod or other device placed with one end on the machine and the other end in the ear or between the teeth. With a view to simplifying this part of the engineer's duties and making it possible for him to locate more readily and accurately the exact position of the knock, the improved twin model Transmit-O-Phone illustrated was recently introduced by the International Metal and Specialty Company, Berlin, New Jersey.

The instrument consists essentially of the headpiece, and twin amplifiers, with connecting hose, vibration disks, and sound-

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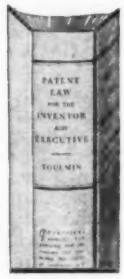

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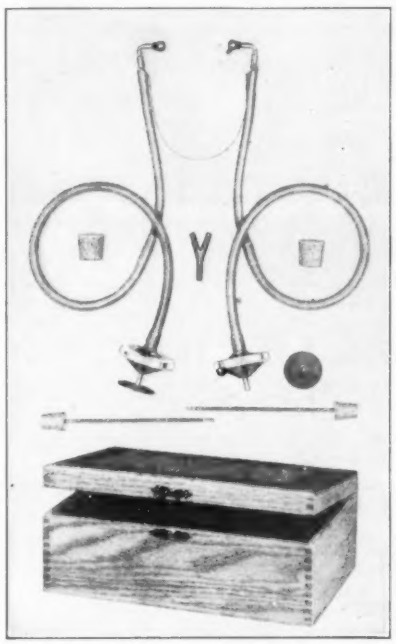
transmitting rods, together with corks to clarify and cushion the sounds.

The advantage of the two amplifiers over one, as generally used on instruments of this kind, is that the location of the knock is more readily determined, and it permits the operator to distinguish two different sounds in close proximity to each other or to detect sounds from two different points at the same time.

The ear tabs are offset to fit snugly and evenly in each ear, and to keep out external sounds. The disks are used for locating light sounds, and the rods with the



The stethoscope-like instrument for locating machinery knocks, explained in the accompanying article

cork tips for sharp or loud sounds, the corks having a cushioning and clarifying effect. The Y-piece is used where one amplifier only is necessary to locate the sound.

Among the uses claimed for the instrument, in addition to those already mentioned, are: detecting leaky steam valves, loose journals, leaky steam traps, leaks in air and water lines, and locating hidden pipes and conduits. It might be used, for example, to locate a ferrule on a street water main, or a paved-over curb box. A man "listening in" on the pipe where it enters the building will hear a distinct, sharp note when a helper outside taps the pavement over the point sought.

The instrument and attachments come packed in a hardwood case.—*Power.*

Many New Uses for Bakelite in the Home

IN the era of building construction through which this country is now passing, great impetus has been given to creation and development of superior building materials, equipment, tools, and supplies. Efforts have been directed toward expediting construction activities through labor-saving devices. Demand for the best facilities has brought manufacturers in competition to supply the most improved hardware, fixtures, and finishings. Architects and builders have readily adopted these im-

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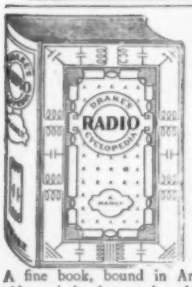

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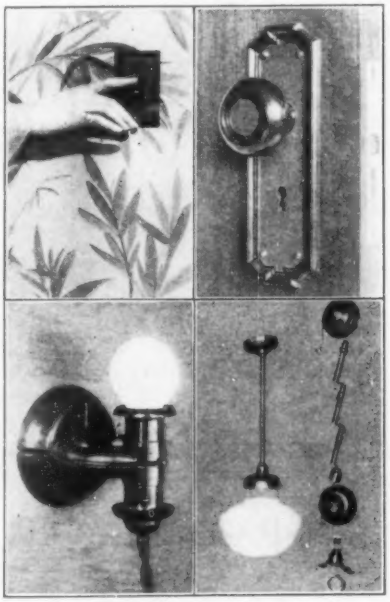
provements, sensing the popular taste for quality.

Science and engineering have co-operated to produce new building materials and devices which have brought revolutionary changes, not only in design, but in dependence upon sources of supply. The science of chemistry has been called upon and has responded with the development of materials from agricultural wastes such as straw, corn stalks and sawdust. The result in many instances has been the development of more durable materials, capable of withstanding heat and the ravages of the elements.

Among building materials which have come into general use during the past year, derived from chemical synthesis, are the bakelite resinoids. These materials are



Some of the many applications to which bakelite may be put. These articles were molded in bakelite

capable of fabrication into many unique forms which make them useful in a wide range of building operations. They are created in the laboratory from chemicals derived from coal and wood—phenol, cresol, and formaldehyde.

Bakelite materials have been adopted extensively in the improvement of tools. The blow-torch, the electric drill, and the paint sprayer utilize them because of their properties of heat and electrical insulation, and resistance to corrosion. They provide molded switch plates and other electrical fixtures, escutcheon plates, door knobs and other hardware. In the electrical field, of course, the phenol resinoid materials have early been recognized for their dielectric strength. Added to this, however, are the properties of mechanical strength, high luster, and the range of color effects in the finished product.

In every room of the modern home these materials may be found in some form—dials in the radio set, the telephone mouthpiece, the cement in electric lamps, outlet plugs, et cetera. The red wheel of the Lorraine stove and the agitator of the Meadows washing machine are other examples. Tables are now made with Bakelite tops undistinguishable from marble, mahogany, or oak.

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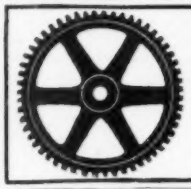

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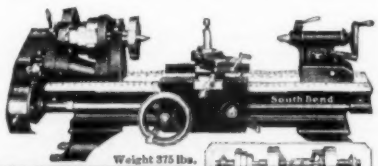

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Industries From Atoms

(*Continued from page* 175)

tive directly to the skin of the hands of the operatives and thus not only neutralize the acid of the skin, but give to the skin a surface coating of the rust preventive which would protect the piston rings from the corrosive influences of the hands while handling? In other words, if it were impractical to slush the rings with rust preventive in process in order to prevent corrosion from the hands, why not slush the hands?

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Will Aminoplastics Replace Glass?

THE advent of Pollopas or "synthetic glass" in Europe a few years ago has produced continued interest in clear resenoid condensation products which may be

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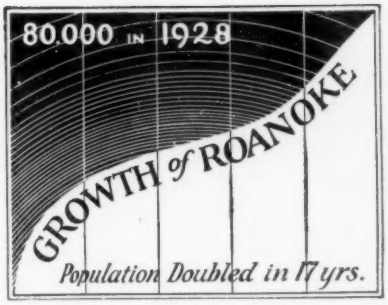
suitable as a substitute for ordinary glass.

"The difficulties that beset the path of the inventors in the early period of this art are gradually being overcome, and it is probably only a matter of a few years before these highly-refractive, clear products will be available at a price that will allow them to compete with other plastic materials," says Carl Marx, writing in a recent issue of *Plastics*.

"Urea, or carbamide as it may be called with equal propriety, forms the basis of a number of valuable clear condensation products. The usual procedure in the past has been the condensation of the material with formaldehyde or a similar methylene group containing substance, and present progress is along these lines. Under suitable conditions, acrolein reacts readily with urea,



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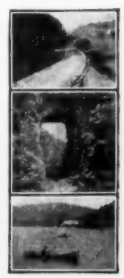

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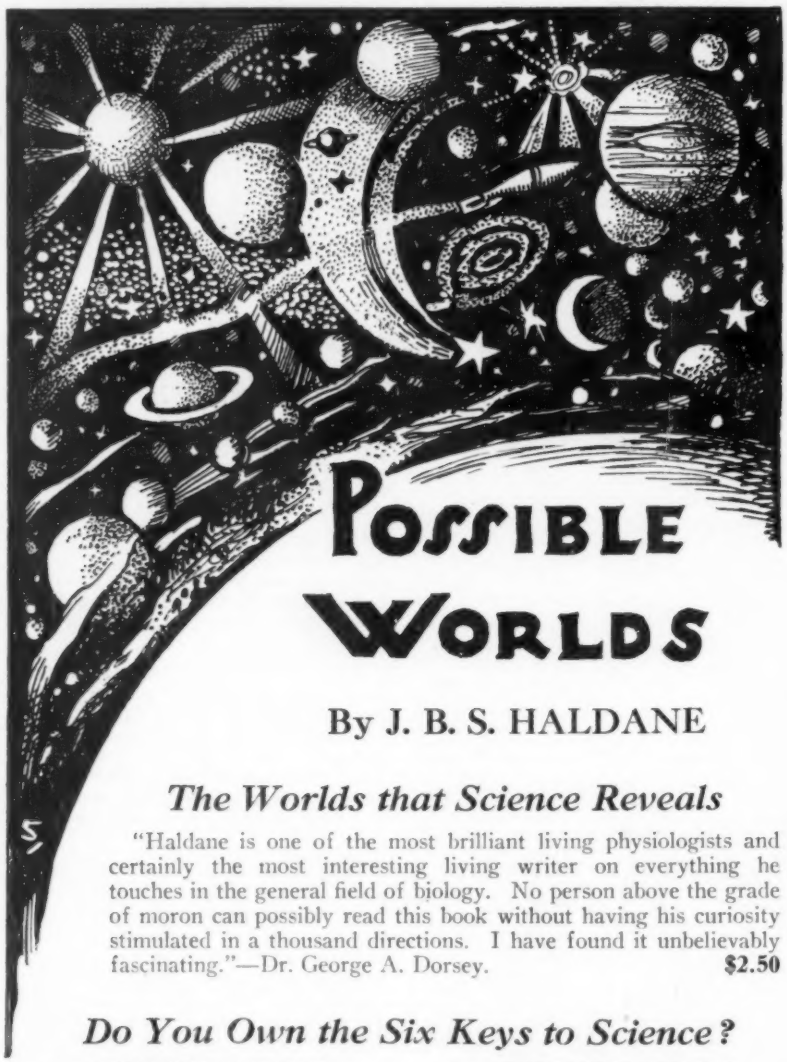

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the course of the reaction depending on the one hand on the proportion of the acrolein to urea, and on the other hand on the presence or absence of catalysts, solvents or diluents and also on the temperature of the reaction."

Rubber-Coated Steel Finds Useful Applications

AN interesting development in chemical engineering which should find useful application in numerous other fields, is a special rubber lining for vessels used for hydrochloric acid. The lining takes the form of a plastic rubber compound, which can be applied to the surfaces of tanks and vessels. It toughens or vulcanizes at 90 degrees, Centigrade. The lining is obtained in sheets of varying thickness. The surfaces of the iron vessels are first cleaned and sweated free from moisture, covered with a special solution and allowed to dry. On this is laid the rubber sheet, carefully rolled to remove all air from between the sheet and the metal. The jointing of two adjacent sheets is done by first rolling down the edge of one sheet, smearing this surface with naphtha, then laying on that the edge of the next sheet and pressing down with a tool heated to 35-40 degrees, Centigrade. When heated to this temperature the rubber lining becomes soft and dough-like.

What Will Happen to the Tin Can

NO doubt every small boy shares the double illusion concerning tin cans; first, that they are made of tin; and second, that empty cans on rubbish piles are devoured by ravenous billy-goats. While most of us lack evidence either to substantiate or disprove the latter tradition, we learned long since that the tin can is really made of sheet iron plated with tin to render it rust proof, inert to the food it contains, easily workable and conveniently receptive to solder.

Data issued recently by the Tin Statistical Research Bureau of London indicate that the world is facing a tin famine. The Bureau points out that the United States, being the greatest consumer of tin, will be the first to feel the effects of the growing shortage of this metal. Since 1919 the world's available stocks of tin have dropped from 13,000 tons in that year to about 4500 tons at the present time. In the last 30 years the price of tin has risen some 500 percent.

It would take a long list to mention the articles into which tin enters as an important material. But there is no doubt but that one of the principal, if not the most important use, is for tin cans. Possibly the growing scarcity of tin will eventually turn the canners to lacquered or perhaps chromium-plated cans. Possibly, sheet iron will be replaced entirely by some other material. J. Newell Stephenson, editor of *Pulp and Paper Magazine* of Canada, sees the possibility of paper or cellulose "cans."

"Cellulose, which is available in unlimited quantities, is not by any means the equivalent of any metal in all its properties," he admits. "We are convinced, however, that research can eventually develop, through parallel work on the preparation of the material used for the container and the treatment of the article to be contained, such co-ordinated processes that cellulose products can be used very largely as successors—we prefer that word in this

instance rather than substitutes—to the metal container now almost universally used. We have no doubt that cellulose will be found to possess properties not more than suspected at the present time, and which will be found to be adaptable to the production of a great variety of products whose value will be more obvious as time goes on."

Paper From Grape Vines

SHADES of Bacchus! That erstwhile popular god must certainly storm the gilded streets of Olympus as he sees the uses to which the native sons of California turn the grape. Grape juice (containing benzoate of soda) must have caused a pang of sorrow; the pretty little red boxes that have induced us to "eat more iron" —as raisins—must have given him wistful pause; but the crowning indignity is now contained in the news that a California company has been formed to manufacture paper made from grape-vine cuttings.

Chemically, and from the paper maker's point of view, this is an interesting project. The new plant, known as the Sacramento Pulp and Paper Company, is to be located in Sacramento and is capitalized at a million dollars. Plans for the initial unit of the plant call for the manufacture of 25 tons of wrapping paper per day, which would give employment to about 80 persons, with a daily payroll of about 500 dollars.

Mr. H. D. Wagnon, one of the directors, is the discoverer of the process for making pulp and paper out of grape vines and has protected it by applying for a patent covering the gathering, treating and manufacturing process.

It was decided to establish the factory in Sacramento because this city is the center of the grape industry of the state. Within a radius of 50 miles are planted about 100,000 acres of grape vines, thus affording for the proposed pulp and paper mill a large supply of raw material.

The use of grape vines is an innovation in the pulp and paper industry. Through utilization of this medium it is confidently expected by the backers of the project that production cost in raw material will be materially decreased.

Tires—Rubber or Zinc?

FEW realize that the ordinary high-class automobile tire contains many other things besides rubber. Zinc oxide, for instance, is used in greater tonnage than any other compounding ingredient for rubber, not alone because it is an excellent white pigment, but also because it reinforces rubber compounds with relatively little sacrifice to their resiliency. The rubber used in tires must, of course, be reinforced in some way, for pure rubber, while resilient, will not stand wear and tear of the road.

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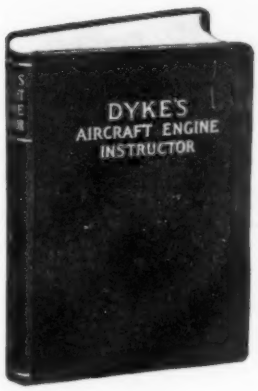

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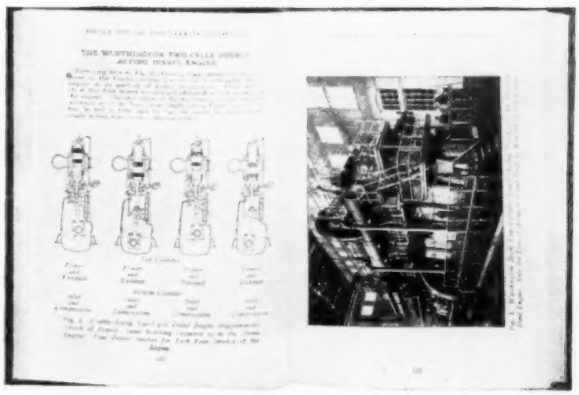

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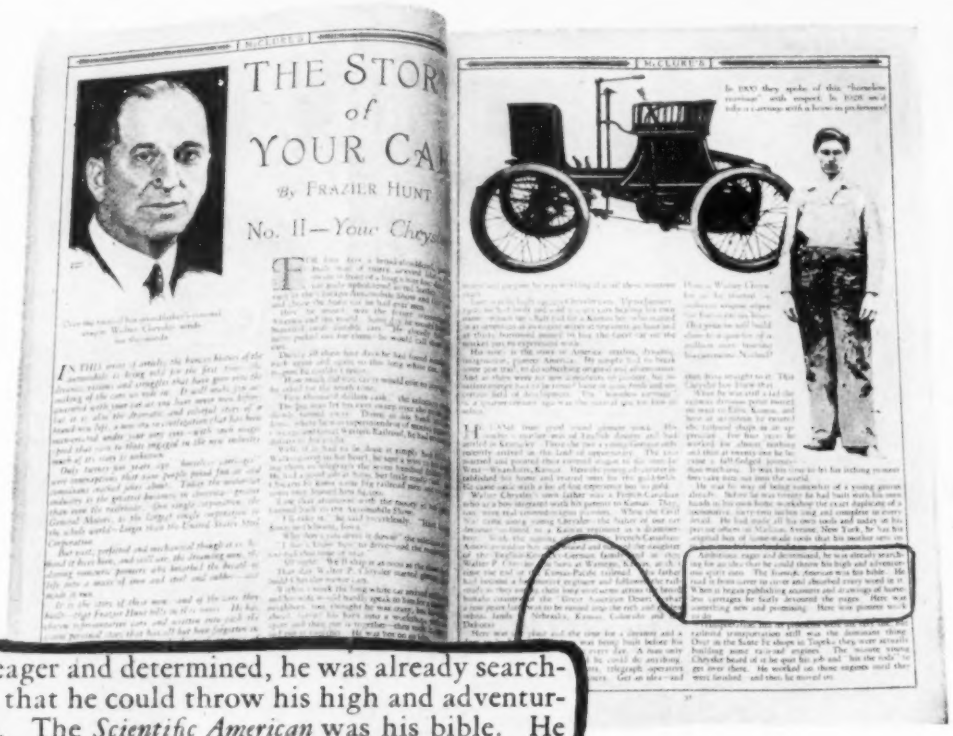
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By FRAZIER HUNT

No. II—Your Chrysler

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Reginald Fessenden, electrical wizard, upon whose epoch-making inventions, the science of radio rests, told in his autobiography published in "Radio News", how reading the SCIENTIFIC AMERICAN turned him from a classical to a scientific career. He said:

> "On the library table at Bishop's College was 'Nature', a weekly scientific publication which became more and more interesting and led me to the more practical SCIENTIFIC AMERICAN, some experiments with electric batteries and my first, very minor invention."

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Safety Pins

A FRIEND of ours was sitting in the office the other day talking about inventions.

"By the way," he said, "did you know that it was my great-grandfather who invented the safety-pin?"

"No," we replied, "tell us about it."

"He had a machine shop. One day, a friend of his came in wearing a cape. It was a cold winter day; the cape was blowing open and the newcomer asked to borrow a pin. My great-grandfather gave it to him. He fastened the garment together with it in a rather clumsy fashion.

" 'Let me show you how to do that,' said my great-grandfather. He took the long pin, bent one end over to form a sort of holder; then he bent the pin into a circle in the middle to form a sort of spring and gave it back to the man.

" 'There,' he said, 'try that. You will find that it will hold your cape more securely; it won't come out and there is no danger of your pricking your finger on the point.'

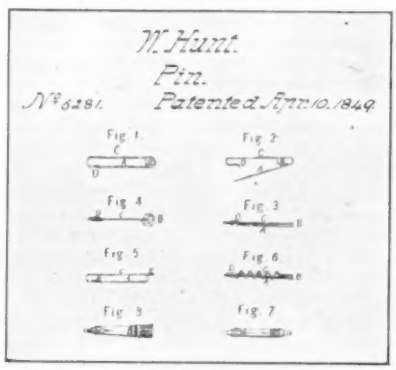
" 'That is a fine idea,' said the visitor, 'you ought to get a patent on it. I bet there will be a lot of money in it.'

" 'Oh, there is nothing to that,' said my great-grandfather. 'It is just one of those things that anybody can do.' The visitor, however, was impressed with the idea and he himself took out a patent, claiming to be the inventor, and made a considerable amount of money out of it."

"What was the name of this great-grandfather of yours?" we asked our friend.

"Walter Hunt."

"Well now, we don't like to upset any family traditions, but it happens that your great-grandfather did take out the original patent for the safety-pin. Whether he made any money out of it or not, we don't



The patent for Walter Hunt's pin, made from a single piece of wire

know; but it just happens that we have a copy of Walter Hunt's safety-pin patent in our desk."

We dug down into the bottom drawer and brought out, much to the surprise of our friend, patent Number 6281, dated April 10, 1849, issued to Walter Hunt, of New York City, for a "Dress-Pin." While dress-pins and clasps of one kind and another have been known since the dawn of history, this, so far as either of us knew, was the first safety-pin patent issued in this country.

"The distinguishing features of this invention," the patent read, "consist in the construction of a pin made of one piece of wire or metal combining a spring and clasp or catch, in which catch the point of said pin is forced and by its own spring securely retained. They may be made of common wire, or of the precious metals.

"Any ornamental design may be attached to the bar, which combined with the advantages of the spring and catch, renders it equally ornamental, and at the same time more secure and durable than any other plan of a clasp pin, heretofore in use, there being no joint to break or pivot to wear or get loose as in other plans.

"Another great advantage unknown in other plans is found in the perfect convenience of inserting these into the dress, without danger of bending the pin, or wounding the fingers, which renders them equally adapted to either ornamental, common dress, or nursery uses. The same principle is applicable to hair-pins."

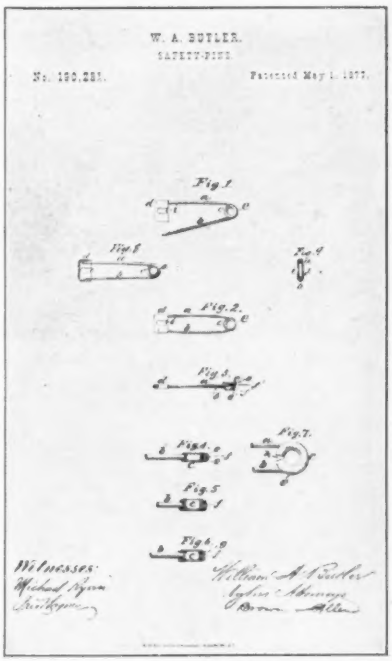
The safety-pin as Walter Hunt conceived it is, in principle, much the same as we know the safety-pin today. There was probably no substantial change or improvement in it for 28 years. In 1877, by which time the term safety-pin had come into use, William A. Butler, also of New York City, obtained a patent.

He provided a re-enforcing ring placed between the bifurcations, explaining his improvement as follows:

"A serious defect in safety-pins avoided by my invention is the liability of injury to fabrics and tissues, caused by a portion of the same working in between the coils of the spring which connects the bifurcations of the pin. In adjusting such pins in portions of the dress, the turning of the pin longitudinally, after the pointed bifurcation is inserted in the fabric, frequently forces a portion (perhaps consisting of a few threads only) in between the coils of the spring, which hold such engaged portion of the fabric so forcibly that it is only by great care disengagement can be effected without breaking out the portion so engaged, which breaking and injury often result in spite of all efforts to prevent it.

"I obviate this action and defect by my re-enforcing ring, which not only strengthens the pin, but prevents any portion of the fabric from engaging with the coils of the bent part when the same is coiled, and which also enables me to obtain sufficient resilience in the spring without coiling the bent portion of the same for a spring between the bifurcations of the pin."

Walter Hunt, the original patentee of the safety-pin, has a place in the history of invention for something entirely different. He is recognized by those familiar with the subject, as the original inventor of the sewing machine. Between 1832 and 1834 he built and sold workable sewing machines—all of his own design. His machine was of a locking stitch variety, that is, it made a stitch consisting of two



Butler's improvement had a guard to prevent catching the clothing

threads twisted together in such a way that they could not be raveled out as easily as could the simple stitches of earlier machines.

He also invented the eye-pointed needle which led to the machines of the present day. He never applied for a patent, however, on his sewing machine inventions until years later. By that time, Elias Howe, whose work was undoubtedly done later than Hunt's, had applied for a patent, and Hunt was too late in taking the necessary steps to obtain the fame and fortune which might have been his rather than Howe's.

Exporters Beware

AMERICAN firms likely to do business in foreign countries are warned against the practices of trademark pirates, by the Commercial Laws Division of the Department of Commerce. Recommendation is made that the Americans protect their rights by prompt registration of the marks.

It is said many instances of piracy have arisen lately. One concerns a certain South American who visited the United States in 1927, calling upon manufacturers of well-known radio apparatus. This year, in his own country, he has registered their trademarks—about 40 in number—in his own name. Protest has been made to the

applications for registration, but probably too late, and the pirate is now in a position to sell his rights to competitors of the American manufacturers and may even confiscate the American goods should they arrive at a port in his country, bearing a trademark of which he is the registrant.

It is admitted that registration of a trademark is impracticable in every country in which goods may at some time be sold, because of the expense involved. In some countries registration is granted to the first applicant for registration. In other countries —and in these the situation is most dangerous—registration is granted to the first applicant, regardless of use. A definite period of time, however, is usually allowed for protesting the application for registration.

In a warning recently issued against trademark pirates, James L. Brown, chief of the Patents and Trademarks Section of the Division, says:

"When a so-called piracy has been committed, the usual course left open to the person believing himself injured as a result thereof is to take action in the civil courts against the infringer, although, in some instances, criminal action may be maintained owing to penal provisions in the laws. American firms, therefore, must be vigilant—not only in protecting their trademarks, trade names, and labels in those countries in which they are now doing business, but also in countries apparently offering potential markets."

The Bureau of Foreign and Domestic Commerce through its foreign offices is assisting American firms to make contacts with foreign business concerns, but it cannot assume the position of an arbiter when the rights of an American firm have been jeopardized through its own negligence. The exporter should rely upon his own vigilance and prompt action.

The Wicker Furniture Case

THE Federal District Court for New Jersey has recently upheld the patent in which Marshall B. Lloyd in 1917 disclosed the invention which revolutionized the manufacture of wicker furniture. Suit was brought by L. H. Greenwood, O. W. Siebert, and W. E. Holman, trustees, against the Monarch Manufacturing Company and the Gardner Fiber Company.

"In the prior art, reed furniture, such as chairs and baby carriages, was hand woven, just as the Aztec Indian made his baskets," Judge Bodine says. "By the Lloyd method, the fabric is separately woven, and applied to the frame. There is a saving of nine hours of skilled reed worker's time in the manufacture of an ordinary wicker chair. In the old weaving art, months were consumed in teaching the worker. The worker can now be trained to apply the fabric in two weeks. The saving is enormous. At least half of the wicker furniture upon the market is now made by the Lloyd process and 99 percent of the Heywood-Wakefield baby carriages are so made.

"The gist of the novelty in Lloyd's invention is in reshaping the material upon the frame to be covered so that neither cutting, nor piecing, nor folding the fabric is necessary. Lloyd saved the industry the tedious hand process of making stake and strand furniture by the hand weaving process. He saw how the fabric could be shaped to produce the same results as were produced by the old and expensive method.

"The defendant, Gardner Fiber Company, manufactures stake and strand fabric suitable for the manufacture of wicker furniture under the Lloyd method, and the defendant, Monarch Manufacturing Company, buys the fabric to use in the manufacture of wicker furniture. Obviously, the Gardner Company knew what the Monarch Company was going to do and persuaded them to undertake the use of their goods. Both defendants are infringing the patent, one by weaving the fabric, and the other by reshaping the fabric and attaching it to the chair frames.

"In administering the patent law the court first looks into the art to find what the real merit of the alleged discovery or invention is and whether it has advanced the art substantially. If it has done so, then the court is liberal in its construction of the patent to secure to the inventor the reward he deserves. If what he has done works only a slight step forward and that which he says is a discovery is on the border line between mere mechanical change and real invention, then his patent, if sustained, will be given a narrow scope and infringement will be found only in approximate copies of the new device."

Patent Appeals Transferred

THE United States Court of Customs Appeals has been changed to the United States Court of Customs and Patents Appeals President Coolidge having signed the bill providing for the change. Heretofore appeals in patent cases have been taken from the Patent Office to the Court of Appeals of the District of Columbia or, in some cases, to some of the numerous United States District Courts throughout the country.

The purpose of the change is explained in a report by the Senate Committee on the Judiciary as follows:

> "The need for the legislation is due to the fact that the Court of Appeals of three judges has a very crowded docket and is considerably behind in its work while the United States Court of Customs Appeals, consisting of five judges, has a relatively light docket. The bill has the approval of both courts as well as the Department of Justice."

Patent Brokers in Germany

IT is no uncommon thing for an inventor to find that marketing his patent is a far more difficult task than making the invention. With manufacturers it is no problem to make a product if they know what to make. The problem lies in finding a suitable article to manufacture. These two needs provide the opportunity for the patent broker.

In industry there is a legitimate place for a patent broker. Unfortunately, however, the business is a difficult one and the rewards in it have at times attracted men whose principles are not of the highest.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT AND AIRPLANE CONSTRUCTION—Which is of compact and symmetrical form, of great carrying power, capable of developing a high speed, and also capable of approximate hovering over any desired point. Patent 16688889. W. Chalmers, 1011 Howell Ave., Sacramento, Calif.

Pertaining to Apparel

SHOE-TIE-CLAMPING DEVICE—An ornament for concealing the knot from view on women's tie pumps, and retaining the ribbon bow in tied condition against accidental displacement. Patent 1668415. J. Mascali and P. Roma, c/o Mascali & Benenati Shoe Co., 3901 14th Ave., Brooklyn, N. Y.

METHOD OF MAKING SHOES—Of the McKay type, of simple construction, attractive in appearance, lighter in weight, considerably more flexible and comfortable to wear than the conventional shoe. Patent 1668479. S. Ansaldo, 1745 80th St., Brooklyn, N. Y.

RUBBER HEEL FOR SHOES—A simple device capable of being readily applied to the heels of shoes, and which is easily detachable when worn to permit of substitution. Patent 1668980. G. H. Schmidt, P. O. Box 31, Alhambra, Calif.

Chemical Processes

SOLUBLE-FOOD PRODUCT HAVING FRESH KOLA AS A BASE AND PROCESS FOR PREPARATION OF THE SAME—The product being immediately soluble in aqueous beverages, and chiefly breakfast drinks such as coffee, tea and like infusions, without altering their taste or appearance. Patent 1669326. A. and E. Chalas, c/o C. Bletry, 2 Boulevard de Strasburg, Paris, France.

Designs

DESIGN FOR A COMBINED DESK SET AND PICTURE FRAME—Patent 74980. H. A. Kretschmer, 401 No. Leavitt St., Chicago, Ill.

DESIGN FOR A LADY'S HAND BAG—Patent 74957. M. Arnold, c/o Herman Schenors Son & Co., 33 Crescent St., Long Island City, N. Y.

DESIGN FOR A STICK-CANDY WRAPPER—Patent 74982. C. R. Luce, 215 Suydam Ave., Jersey City, N. J.

DESIGN FOR A POCKET LIGHTER—Patent 74988. W. Raeburn, c/o Bernhardt Co., 127 W. 30th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE BRACKET OR SIMILAR ARTICLE—Patent 74965. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A CURTAIN TASSEL OR SIMILAR ARTICLE—Patent 74966. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE END OR SIMILAR ARTICLE—The inventor has been granted four patents for ornamental designs of this nature. Patents 74962, 74963, 74964, 74967. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

There have been many experiences of inventors which justify scrutinizing closely the ways and methods of any man or firm seeking to act as intermediary between the inventor and the manufacturer.

In Germany an interesting experiment is being undertaken. A limited number of patent brokers, who wish to distinguish themselves from others in the business who are not entitled to public confidence, have formed a "Chamber of Industrial Brokers" (*Kammer Deutscher Industrie-Makler*). The object of the institution is to establish and maintain the reputation of the profession of its members. It co-operates closely with the Government Board of Industry and Commerce, with other official institutions and with registered patent attorneys. Members are admitted only after careful examination and may be excluded for any breach of business ethics. All inquiries which may be addressed to the institution are submitted at regular meetings and distributed among the members.

So far the idea seems to work out very well in practice. One firm will have unusual facilities for marketing a patent in a particular country or in a particular industry and it is not uncommon for one broker to refer an inventor to another broker who is better qualified in the particular case. Such co-operation, instead of cut-throat competition, naturally works to the benefit of the inventor. The members are all familiar with the tactics of the other members and are, therefore, in a position to prevent anything which might tend to lower the standing of the profession.

Such an experiment is not new in business, but it is new in connection with the marketing of patents. It might be a good idea to have such an organization established in the United States.

The Safety Razor Cases

AS everyone knows, the real profit in the safety razor business lies not in the razors themselves, but in the blades. A manufacturer uses the same trademark for both razors and blades, and he can, of course, prevent another manufacturer from using the trademark. Suppose, however, that another manufacturer makes and sells razor blades which he labels as suitable for use in a trademarked razor. In such a case can the original safety razor man get an injunction?

About this question revolved the recent suit of the American Safety Razor Corporation against the International Safety Razor Corporation and others. In the course of the hearings in the Federal District Courts in both New Jersey and Southern New York some interesting facts about the merchandising of safety razor blades was brought to light.

The American corporation makes and sells the "Gem," "Ever-Ready," and "Star" razors and blades; its annual sales of blades alone aggregating more than a hundred million. When the company was formed in 1919, three of the largest companies in the country were absorbed. The Gem corporation was paid 4,000,000 dollars in cash, 3,600,000 dollars of the sum representing the value of the name "Gem," the equivalent of 4,560,000 dollars was paid to the American company for the trade name "Ever-Ready;" and 278,000 dollars was paid for the assets of the Star corporation, all but 28,000 dollars of the total sum representing the estimated good will value of the trade name "Star."

In the next six years more than 4,000,000 dollars was spent in advertising to popularize the three brand names. In all forms of advertising, about 8,000,000 dollars has been spent, but in rare instances only has there been mention that the American Safety Razor Corporation is the manufacturer and seller. The public, therefore, does not know that the "Gem," "Star," and "Ever-Ready" are all made and sold by the same manufacturer. The blades have all been standardized as to size and any one of the three blades could be used with any one of the three razors.

Along came the International Corporation, making razor blades and frames under the trade names "Sha-ve-zee," "Liberty," "Mirak," and "Bryford." Blades bearing these names are sold in the ten-cent stores and elsewhere, the package stating that they may be used with "Gem," "Star," or "Ever-Ready," razors. The American Corporation contended that the purchasing public was being deceived into believing that the cartons contained the American's blades.

In the New York Southern District Court Judge Hand issued an injunction against F. W. Woolworth Company, restraining it from selling International's products featuring especially the American's trade names; he permitted, however, a limited use of the American's names in a form which he specified. The wording he approved of was as follows: "Will fit Sha-ve-zee, Gem, Liberty and other razors." The American corporation protested that the relief was insufficient and brought action in the Federal District Court in New Jersey. In denying an injunction, Judge Runyon said:

"It would appear to me that any mental process which could arrive at an erroneous conclusion as to identity of product after inspecting this carton or placard, is either woefully slipshod in its workings, or merits the charge of inherent incompetence.

"As may well be imagined, the complainant has put out an immense volume of advertising, more especially in the exploitation of its Gem and Ever-Ready razor blades. The advertising bears every earmark of intense business rivalry and one could never guess from perusal of these public announcements that the competition between them was any less keen than their own boasted razor edges, concerning the virtues of which the field of fitting superlatives has been drawn upon almost to the point of extinction.

"To me it appears perfectly clear that if the public knew the truth, it would buy that blade of complainant which is sold at the smallest price, and that its ignorance is costing it money without warrant every time it buys a blade at any figure beyond the minimum. Complainant's counsel talks about greater exploitation expenses and urges that fact as one reason for a larger selling price. Why should the vendor be able to collect from a purchaser as a part of the purchase price, money which has been spent in an effort to mislead that very purchaser in making that very purchase? I cannot see it.

"As previously suggested, I have taken this matter up without regard to formal pleadings, but for the reason that the public's rights seem to be largely involved, and much more liable to injury through the complainant's practices than through those of the defendants."

Electrical Devices

VARIABLE GRID LEAK—By means of which the reception of the radio waves may be improved by the changing of the resistance. Patent 1668012. A. E. J. Gardner, 853 Lile Ave., Apt. "E," Chicago, Ill.

ELECTRICAL CONDUIT FITTING—Whereby the use of screw threads is entirely eliminated and spring metal sleeves are substituted, for securing electrical conduits to outlet boxes or the like. Patent 1670259. J. J. Herlbauer, 199-23 Hillside Ave., Hollis, L. I., N. Y.

RADIO DIAL CONSTRUCTION—Which will permit one dial to be used to indicate the relative position of two or more adjustable elements, readily applicable to ordinary panel boards. Patent 1670272. A. J. Neef, 1073 E. 39th St., Brooklyn, N. Y.

Of Interest to Farmers

GRAIN SPREADER—Adapted to spread grain when it is being delivered to the furrow so that the seeds will not be crowded and thus cause inferior plants. Patent 1668391. D. Bailey, 108 E. Logan St., Tecumseh, Mich.

SEED FEEDING AND SPACING ATTACHMENT FOR PLANTERS—An attachment for planters of ordinary construction, which will control the dropping of seeds, particularly cotton seed, at desired intervals, providing economy in seed, and in plant thinning. Patent 1669331. E. W. Fullilove, Box 469, Shreveport, La.

THRASHING MACHINE—A small light readily portable apparatus which will effectively accomplish the complete separation of grain from straw, for all kinds of small grain. Patent 1670273. G. E. Nye, McCook, Neb.

APPARATUS FOR TREATING VEGETATION—Especially adapted for spraying or fumigating crops for the purpose of destroying insects and arresting the progress of disease, particularly effective with boll weevil. Patent 1669435. W. W. Wheeler, General Delivery, Shellyville, Ky.

Of General Interest

SPINE SUPPORT—Which may be loosely placed or suspended on a chair of conventional design, and adjusted to fit different sized persons, at the small of the back. Patent 1667626. M. Epstein, 207 Clinton St., New York, N. Y.

COMBINED TENT AND SWING FRAME—Comprising a frame of tubular sections which may be firmly secured for supporting the cover of a sleeping tent, and one or more swinging cots. Patent 1666961. H. E. Delvin, 1412 Ashland Ave., Evanston, Ill.

WALL CONSTRUCTION—Which will provide air circulation, and insulate against heat, cold and dampness, which will conceal bonding material, and insure a proper alinement of the blocks. Patent 1667160. E. H. Kleinfeldt, 1 East 213th St., New York, N. Y.

RUG OR CARPET BEATER—Which may be operated without laborious effort, without the application of electrical or mechanical power, and without injuring or wearing the rug or carpet. Patent 1667605. D. P. Ransom, Woodstock, Vt.

MOP—Which may be cleaned in a bucket of water and wrung for the purpose of drying without the operator touching the wiping element. Patent 1666371. A. De Rose, 37 No. Monterey St., Gilroy, Calif.

TOWEL RACK—Capable of holding a multiplicity of ordinary towels in such manner that individual and successive use is permitted yet securely locked against theft. Patent 1666063. A. W. Aubrey, 427 East 23rd St., Los Angeles, Calif.

BOOK REST—Which can be folded to relatively small size, or extended for supporting books, magazines or articles of various sizes in open position, permitting easy "turning." Patent 1667171. F. D. Sholin, 823 Norwood Ave., Toledo, Ohio.

COMBINED COFFEE CHURN AND STRAINER—Which will hold the coffee grounds suspended, to be agitated by the boiling water, a perforated container permitting the water to pass through the solution. Patent 1668454. C. Y. Hake, 1450 Mt. Rise Ave., York, Pa.

COMPASS BUBBLE BOX—Having a cover glass with small dome thereon into which any bubble will rise and not interfere with the proper reading of the compass. Patent 1668425. F. G. Senter, 51½ Exchange Place, Portland, Maine.

TEMPLATE—By which it is possible to form singly various characters, such as the letters of the alphabet, digit numerals, and the punctuation marks used in writing. Patent 1668396. J. F. Carroll, Avoca, Wis.

HAIR WAVER—For imparting what is known as a permanent marcel wave, adapted for waving the hair on one side of the head at a single operation. Patent 1668430. H. Snodgrass, Box 135, Bisbee, Arizona.

PRODUCING REFINED SUGAR—From cane juice molasses or beet root whereby at a slightly added cost per kilo refined sugars are produced directly, or at a still lower cost a lower grade of refined sugars may be produced. Patent 1668470. M. R. J. Schmid, c/o G. Brewer, Maipu 671, Buenos Aires, Argentina, S. A.

PAD FOR DECORATING—By which a decorator may simultaneously produce a design and stippling effect, on walls or freshly painted surfaces. Patent 1667841. F. F. Conwill, 5101 Kenmore Ave., Chicago, Ill.

DISPENSING DEVICE FOR PASTE TUBES—Capable of receiving collapsible tubes for tooth paste, or the like, of various sizes, and so compressing the tube that the paste may be dispensed without waste. Patent 1668296. C. C. Wells, 219 Sixteenth St., Hermosa Beach, Calif.

WINDOW CLEANER—Which may be used from the inside of a window for cleaning the outside surfaces thereof easily and quickly. Patent 1669293. O. Grossmann, 153 Ave. "B," New York, N. Y.

SMOKING PIPE—Formed of two flat sections laid one upon the other, and clamped together, may be readily disassembled for cleaning, repair, or storage. Patent 1669353. A. J. Sorbello, 365 Washington St., New York, N. Y.

KNOCKDOWN RECEPTACLE—Made of light gauge metal and having interengaging portions which may be secured together without the use of screws or nails, especially adapted for fruits or vegetables. Patent 1669300. J. W. Hunter, Box 962, Mobile, Ala.

APPARATUS AND METHOD OF PERMANENT HAIR WAVING—Wherein all parts of the hair are subjected to substantially the same amount of moisture as well as the same amount of heat. Patent 1668868. R. A. Porta, 309 Anza St., San Francisco, Calif.

DRAFT ARM FOR SODA FOUNTAINS—In which any liquid retained in the draft arm, which has previously been drawn from a cold supply, will remain cold while in the arm. Patent 1668635. T. De Stefani, c/o Liquid Carbonic Corp. 3100 So. Kedzie Ave., Chicago, Ill.

BINDER—A sectional binder capable of binding loose leaves together in such manner that there is no possibility of any being accidentally lost. Patent 1668813. W. J. H. King, c/o Union Lithograph Co., 741 Harrison St., San Francisco, Calif.

BULLETIN BOARD—Which may be set up in a store for displaying want advertisements as well as advertisements of the store and activities in the particular neighborhood. Patent 1669308. L. D. Smith, 9155 Chicot Court, Ozone Park, L. I., N. Y.

SECTIONAL SMOKING PIPE—The parts being so constructed that they are easily held together and may be readily separated for cleaning, the ducts are small, and the smoke is cool. Patent 1669369. D. Barker, c/o A. J. Sorbello, 365 Washington St., New York, N. Y.

TOILET KIT—In which a shaving apparatus and other toilet accessories, are securely retained within a small compact case for transportation without danger of injury. Patent 1670177. J. N. Young, 179 E. 80th St., New York, N. Y.

JAR-CAP REMOVER—A gripping tool in which the jaws and operating handle are relatively adjustable for use upon jars or other objects of varying diameters. Patent 1670188. L. F. Castelli, 3787 Hudson Blvd., North Bergen, N. J.

SLACK TIGHTENER FOR PULLEY CLOTHES-LINES—By which the expansion and contraction of the line, may be readily adjusted by means of a specially formed webbed and notched plate, attached thereto. Patent 1670257. L. Hagen, 94 Fulton Ave., Jersey City, N. J.

HIGH-LIGHT PROCESS FOR PHOTO-ENGRAVING—Which comprises making half-tone and plain negatives from the same subject, retouching a print from the plain negative, making a new negative, and printing from the superimposed negatives. Patent 1670195. F. J. M. Garland, c/o Walker Engraving Co., 141 E. 25th St., New York, N. Y.

RUBBER ARTICLE—A hollow integral rubber article, having a hollow cardboard air-filled mandril completely embedded therein, the product being used as a bumper of any desired nature. Patent 1669854. O. T. Bugg, c/o Hotel Madison, 27 St. & Madison Ave., New York, N. Y.

SAFE CONSTRUCTION—Having an outer face plate so formed as to preclude the possibility of successfully breaking into the safe before an alarm is given. Patent 1669486. P. E. Pyle, c/o Schwab Safe Co., 1204 Columbia St., La Fayette, Ind.

CONCRETE WALL CONSTRUCTION—Comprising easily assembled forms having parallel guides supported and clamped one above another, adapted for vertically aligning a wall as it is built upward. Patent 1670057. C. M. Alley, 37A Barron Ave., San Mateo, Calif.

Hardware and Tools

JAR-HANDLING TOOL—For handling hot fruit jars when being filled, may be conveniently manipulated and adjusted, for applying or removing caps of various forms of containers. Patent 1667620. C. E. Bonge, c/o E. A. Houston, Niobrara, Neb.

APPARATUS FOR SHARPENING HANDSAWS—Adjustable to hold saws, and files of various lengths, in such manner that a file can be manually reciprocated to sharpen the teeth throughout the entire length. Patent 1666395. L. S. Miller, 1427 Santee St., Los Angeles, Calif.

TOOL FOR PLANING VALVE SEATS—Adapted to accommodate blades of various characters for planing simultaneously the inner and outer edges of a valve seat of an internal combustion engine. Patent 1667218. T. S. Purnis, c/o K. O. Lee & Sons, Aberdeen, So. Dak.

WATER-CLOSET SUPPORT—Which will be concealed in the wall and floor and may be adjusted to the varying sizes of fixtures of water-closets, sinks or baths. Patent 1667593. R. T. Frye, Box 142, Blauvelt, N. Y.

COMBINATION PADLOCK—Constructed to effect a secure locking, and provided with means for changing the combination, to prevent or make difficult the opening by unauthorized persons. Patent 1668441. F. O. Willey, c/o Dr. P. R. Mort, Teachers College, Columbia University, New York, N. Y.

VALVE—For spigots as well as general use, wherein the valve key will be reciprocated, while the operating member thereof will be rotated. Patent 1668455. C. H. and A. P. Horn, c/o A. P. Horn, 40 Elmhurst Ave., Elmhurst, N. Y.

PIPE GRIP—Of the type embodying a gripping member and a rope, the arrangement being designed to prevent displacement of the gripping rope. Patent 1669322. F. L. Boyd, c/o E. N. Collidge, 425 Ford Building, Great Falls, Mont.

SELF-LOCKING DEVICE FOR COUPLINGS—For use in connection with drilling tool joints, where it is necessary that the joints be locked against accidental uncoupling on removal from the well. Patent 1669186. F. S. Bunker, P. O. Box 1147, Compton, Calif.

VISE—Adapted to be held to a work table or the like, and in which the jaws are turnably adjustable about the axis. Patent 1670194. F. A. Fontaine, Auburndale, Mass.

REMOVABLE VALVE-STEM PROTECTOR—Which may be placed around the stem without removing the hand-wheel, will prevent corrosion, preserve the packing, and prevent rust when the valve is closed. Patent 1670241. W. W. Conner, 30 Church St., New York, N. Y.

ARMOR-CUTTING TOOL—Adapted to sever the armor or conduit of an electric cable formed of spirally wound interengaging metal coils without danger to the cable. Patent 1670250. F. Froschhauser, c/o Triangle Conduit Co., Dry Harbor Rd. & Cooper Ave., Brooklyn, N. Y.

DEVICE FOR APPLYING BOX STRAPS—For simultaneously deforming portions of the overlapped ends, in such manner that the strap will be in rigid engagement throughout its entire length. Patent 1670201. F. L. McGary, Hardinsburg, Ky.

SAW SET—Wherein the saw set itself is positioned in operative relation to the saw blade, and a blow struck with a hammer by the operator. Patent 1670949. G. Anderson, 510 Broadway, Seattle, Wash.

Heating and Lighting

HEATING DEVICE—A gas burning heater which may be readily and safely installed in the floor of a room, and regulated for an even distribution of heated air. Patent 1666367. L. F. Clausing, 3588 20th St., San Francisco, Calif.

HEATING APPARATUS—A portable electric heater, including means for not only distributing the heat to various parts of the room, but for intensifying the heat before distribution. Patent 1668417. S. M. McConnell, Box 3054, Tampa, Fla.

HEATING ELEMENT—An electric apparatus, adapted to raise the temperature of water in a hood shaped container to a predetermined degree, for use in chicken brooders. Patent 1668477. H. Westergaard, Solvang, Calif.

AUTOMATIC FUEL-OIL SUPERHEATER—For pre-heating fuel to be used in a furnace for the purpose of heating water and generating steam in hot water or steam heating systems. Patent 1667713. G. Baker, 708 University St., Seattle, Wash.

OIL BURNER—Designed to produce a maximum breaking up or atomization of heavy oils, and a thorough mixture of the atomized oil with air prior to its ignition. Patent 1669810. C. F. Clapham, 6745 Ridgeland Ave., Apt. 3, Chicago, Ill.

Machines and Mechanical Devices

PISTON AND PISTON-RING CONSTRUCTION—In which thin edged flexible piston rings are carried in V-shaped grooves, and held by means of spring tension against the walls of the cylinder. Patent 1666966. R. G. Hill, 251 East Union St., River Falls, Wis.

BOILER-TUBE CLEANER—Which may be projected into the flue and then expanded to the diameter so that the material coating the pipe may be withdrawn. Patent 1667169. P. Ruck and M. Schutz, c/o Samuel Lewis, 2 Broome St., New York, N. Y.

WAVE MOTOR—Mounted in respect to the water so that the mechanism may be operated by the raising and lowering of floats, to produce power from wave motion. Patent 1667152. M. Hegge, 128 South Mountain View Ave., Los Angeles, Calif.

UNIVERSAL JOINT—Which will not be subject to undue strains, the parts being so correlated as to render them immovable circumferentially

to set up undue wear. Patent 1667455. E. G. Burns, 2763 Fruitdale St., Los Angeles, Calif.

SEALING VALVE FOR GAS LINES—Adapted to be installed when sealing off a supply line, at a point where the line is connected at an angle to a distributing house line. Patent 1667034. H. B. Hatton, 725 Cordova Ave., Glendale, Calif.

APPARATUS FOR MANUFACTURING MATCHED FLOORING—Including side and end matchers, between which the flooring strips are conveyed for tonguing and grooving, and saws for removing knots and imperfections. Patent 1667668. C. R. McLaughlin, Deridder, La.

DERRICK—Of the knock-down type, formed of a plurality of elements which are interchangeable and may be readily assembled or disassembled without destruction of any part. Patent 1667582. N. B. Briggs, c/o Western Iron & Foundry Co., Wichita, Kans.

VALVE—Which is provided with means whereby the packing employed therein may be ret moved without shutting off the valve. Paten-1667203. H. C. Harris, 1544 Central St., Denver, Colo.

DEVICE FOR CEMENTING WELLS—A novel form of device which makes provision for the escape of gas in the cementation of one-string wells, also avoids agitation of the cement. Patent 1667649. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

PRESSING MACHINE—Particularly adapted for use in clothing factories, for pressing and smoothing down the edges, seams, and other thickened portions of a garment. Patent 1668501. S. Goldstein, 55 East 8th St., New York, N. Y.

AUTOMATIC VALVE FOR GAUGES—A construction wherein a tank gauge may be caused to properly function without danger of loosing any of the mercury forming part thereof. Patent 1667877. R. Star, 84 Flushing Ave., Brooklyn, N. Y.

CARDING-MACHINE-APRON OILER — Having automatic means for constantly distributing to the surface of the moving belt or rub apron the proper amount of oil to keep the apron pliable. Patent 1668433. F. H. Thomasson, c/o Unity Spinning Mill, Lagrange, Ga.

CLEANING AND COATING MACHINE FOR PIPES AND THE LIKE—Operable to receive and continuously feed pipe therethrough in such manner that the surface cleaning and coating may be automatically performed, and with great thoroughness. Patent 1668265. H. S. Christopher, 607 West 1st St., Los Angeles, Calif.

MANTLE OF MOLDS FOR CASTING STEREOTYPE PLATES—Having a comparatively large air chamber in rear of wall carrying the matrix, and a shallow water chamber between the air chamber and back wall. Patent 1669316. C. Winkler, c/o Winkler, Fallert Co., Berne, Switzerland.

APPARATUS FOR EXTRACTING OIL FROM SHALE—Comprising a gravity chute for feeding shale to a retort, and means extending into the retort for drawing off vapors distilled therein by the heat of combustion. Patent 1668820. W. Rhodes, 578 Bancroft Ave., San Leandro, Calif.

CIRCULAR KNITTING MACHINE — Having means for automatically repeating the doubling of the stitches in courses spaced predetermined distances apart in the fabric according to the length of the stocking. Patent 1669296. A. F. Harris, c/o Samuel Owen, 361 Pearl St., New York, N. Y.

WINDMILL—Which produces a suctional power resulting from a partial vacuum, greatly increasing the amount of power for operating the wind wheel in much lighter winds. Patent 1670186. I. M. Brandjord, 517 6th Ave., Helena, Mont.

HITCH FOR LAWN MOWERS—For attaching a lawn mower in front of a tractor, permitting the use of mowers of different widths, and allowing a maximum of flexibility in turning. Patent 1669787. S. W. Shaw, Galesburg, Kansas.

APPARATUS FOR THE MANUFACTURE OF FANCY KNITTED FABRICS ON CIRCULAR KNITTING FRAMES—Having means whereby the threads may be instantaneously reversed to produce variable designs in different colors, or vertical stripes, visible on the face or back. Patent 1670208. G. Nigra, c/o G. Capuccio, via Arsenale N. 17, Turin, Italy.

UNIVERSAL JOINT—Having a pair of coacting forks and an articulated ring so connected as to properly transmit power while permitting a limited motion toward and from each other. Patent 1670175. T. S. Wikoff, 306 E. 2nd St., Plainfield, N. J.

LUBRICATING GUN—For liquid greases, so constructed that a powerful thrust of the lubricant ejecting piston is rapidly obtained by a rach and pinion movement. Patent 1670210. F. W. Parker, 957 Hayes St., Apt. 8, San Francisco, Calif.

RADIATOR - TRANSPORTING APPARATUS—Which may be readily applied to a radiator so that the same may be manually lifted and carried by mechanics, or wheeled by one mechanic. Patent 1670196. J. B. Heiser, 423 Park Ave., Williamsport, Pa.

Medical Devices

REVOLVING BED—Adapted for use in moving a patient to an inclined or any desired position, for permitting a wound or other injury to be readily worked upon. Patent 1667982. R. W. Pearson, 70 Fourth St., Laurium, Mich.

TRUSS—Having a pad-supporting element constructed of a yieldable tubing which prevents marking of the body and is therefore particularly adapted for use upon infants. Patent 1669354. C. A. Soriano, 195 Montrose Ave., Brooklyn, N. Y.

MENSTRUAL SPONGE—A readily applied device for efficiently controlling the flow in a sanitary and comfortable manner, and for the prevention of soiling or staining clothing. Patent 1669295. A. Hallenberg, c/o Fargo Clinic, Fargo, N. D.

Prime Movers and Their Accessories

IGNITER FOR INTERNAL-COMBUSTION ENGINES—An abrasive wheel, and a co-acting contactor engagable therewith when ignition period arrives, for producing a stream of sparks in a downward direction. Patent 1666967. H. A. W. Howcott, 320 Kernan Bldg., 317 Fla. St., Baton Rouge, La.

INTERNAL-COMBUSTION MOTOR—A construction which is practically vibrationless because of the absence of pivotal connections between the piston rods and pistons, slidable valves eliminating the usual noisy tappets. Patent 1667213. P. Marchetti, 735 Montgomery St., San Francisco, Calif.

Pertaining to Recreation

GAME BOARD FOR GAME PIECES AND SURFACE PROJECTILES—Requiring the skillful manipulation of the surface projectiles in knocking the game pieces of another player from their respective characters, without disturbing his own. Patent 1666474. O. D. Sorell, 1122 Ogden Drive, Los Angeles, Calif.

GAME—Comprising a casing and partitions forming a plurality of compartments through which a ball passes, and a bunker and trap for making the game more difficult. Patent 1668873. J. C. Sheller, 410 St. Charles Rd., Haywood, Ill.

FISH LURE—For trolling or casting, so constructed that when drawn through the water it will have a snappy, diving, zig-zag movement simulating an injured minnow. Patent 1669350. J. A. Sebenius, 960 4th St., Bremerton, Wash.

ARTIFICIAL BAIT—Constructed to prevent the hooks from engaging weeds, but requiring no spring action for projecting the hooks when the bait is struck by a fish. Patent 1670174. H. P. Wiersma, c/o E. J. Babbitt, Holland, Mich.

MECHANICAL TOY—Which comprises a frame, within which is a rotatable drum propelled by the upward and downward motions of a toy figure, while swinging backward and forward. Patent 1670,249. E. E. France, Box 398, Holyoke, Colorado.

Pertaining to Vehicles

AUTOMOBILE STEERING MASTER—Mechanism in combination with the axle, by means of which a car is held steady in a straight ahead position, and righted after a turn. Patent 1666386. C. A. Johnson, 2945 34th St., Sacramento, Calif.

TRANSMISSION STAND—A tilting holder for adjustably supporting and clamping any conventional type of automobile transmission case, in proper position for repair, or other work. Patent 1667616. H. J. Wright and G. Shirk, c/o H. J. Wright, Box 784, Waynesburg, Pa.

GLARE SHIELD—Which will protect the eyes from the glare of oncoming headlights, yet will enable the driver to take full advantage of the increased lighting effect. Patent 1667658. H. G. Egley, 131 2nd Ave., Long Branch, N. J.

SUSPENSION DEVICE FOR VEHICLES—In which the rear springs are concealed in the interior of the vehicle frame and are supported by the cross-pieces of the frame and the thrust tube. Patent 1668423. C. Schaeffer, c/o C. Bletry, 2 Boulevard de Strasburg, Paris, France.

RESILIENT SUPPORT FOR CUSHION SEATS—Which includes a stationary frame and a seat rest, also a compartment for the storage of tools or other articles, expecially designed for vehicles. Patent 1668473. A. Weickman and C. S. Olmsted, c/o Albert Weickman, 218 E. 59th St., New York, N. Y.

BRAKE-OPERATING MECHANISM—Which is adapted to effect a quick and positive application of a braking action on each of the front wheels of an automobile. Patent 1668436. G. Walker, General Delivery, Russell, Ky.

GREASE CUP—Greatly facilitating the application and distribution of the lubricant to the entire parts of the machine upon which it is mounted, designed for use on automobiles. Patent 1668510. T. P. Martin, Oklahoma City, Okla.

VEHICLE SIGNAL—Adapted to be attached to a windshield frame, or like support, to extend laterally, and indicate the direction the car is about to take. Patent 1669332. J. B. Gabrielson, La Center, Wash.

AUTOMOBILE HOOD LATCH—A concealed automatically-acting latch means, which may be readily attached to any standard car, to prevent unauthorized opening of the hood. Patent 1669356. E. A. Stevenson, 468 Walnut St., Elizabeth. N. J.

DEVICE FOR FACILITATING THE REMOVAL OF SHACKLE BOLT—From automobiles and similar vehicles, the device consists of a standard with threads, and an adjustable U-shaped clamping device from engagement with the springs. Patent 1669352. H. J. Sloan, c/o Haywood Electric Power Co., Waynesville, N. C.

ATTACHMENT FOR MOTOR EXHAUSTS—In the nature of a sounding device, whereby an ordinary layman can tell by the particular sound whether or not the engine is operating properly. Patent 1670200. W. A. Luukkonen, 216 E. 3rd St., Brooklyn, N. Y.

LUBRICATING DEVICE—In which only a predetermined quantity of oil or grease is forced into the various parts of a car, may be quickly secured to standard automobiles. Patent 1669615. C. F. Hoofer, 549 W. Washington Blvd., Chicago, Ill.

SIGNAL—A permanently attached, or detachable, device to be worn on a glove, or semi-glove, and used as a signal by automobile drivers. Patent 1670176. L. C. Woolery, Box 1804, Bisbee, Arizona.

PATENTS

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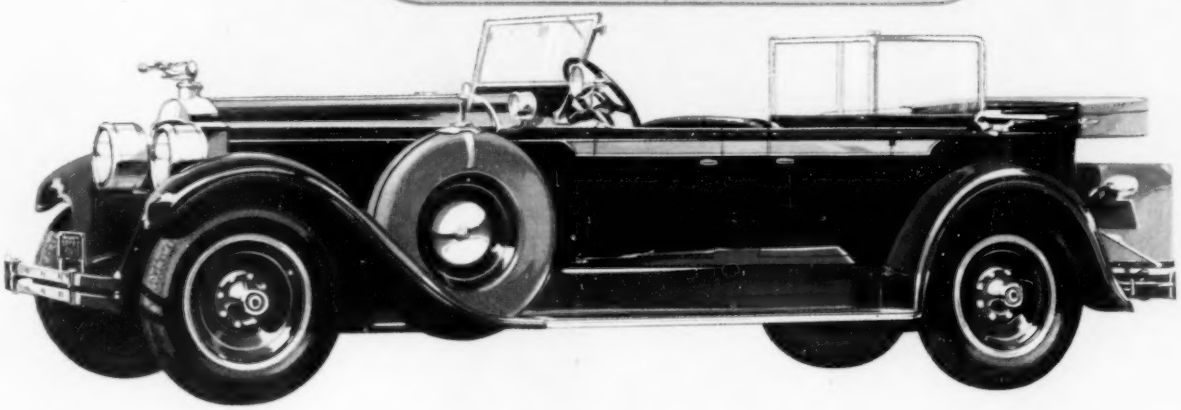

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